COLLEGE OF ENGINEERING CORNELL UNIVERSITY

the Cornell engineer

DECEMBER, 1955
VOL. 21, NO. 3
25 CENTS

Robert T. Blake, Class of '49

speaks from experience when he says,

"At U.S. Steel, the opportunities are unlimited."

Bob Blake had his first experience in steel mills working there during summer vacations from college. After receiving his B.S. degree in Electrical Engineering, he became an operating trainee in U.S. Steel's Irvin Works. During his training program, his background and versatility were used by the Training Division to develop a training program for Electrical Maintenance employees. By the end of 1951, Mr. Blake had become a Foreman with experience in both Cold Reduction Maintenance and the Galvanizing Department.

Effort is made to have young engineers obtain varied experience before devoting themselves to one field. Mr. Blake feels that, "An engineering graduate has practically no ceiling provided he has the right attitude and is willing."

Promoted again in 1954, Mr. Blake is now Foreman—Electric Shop in Central Maintenance. Supervising a crew of 40 men, he is responsible for electrical construction work, maintenance and crane wiring. Mr. Blake feels he is in "an interesting and challenging field of work." He has found that "U.S. Steel is a highly desirable employer in this most basic of all industries."

If you are interested in a challenging and rewarding career with United States Steel and feel you are qualified, further information is available from your college placement director. Or, we will gladly send you our informative booklet, "Paths of Opportunity." Just write to United States Steel Corporation, Personnel Division, Room 1622, 525 William Penn Place, Pittsburgh 30, Pa.

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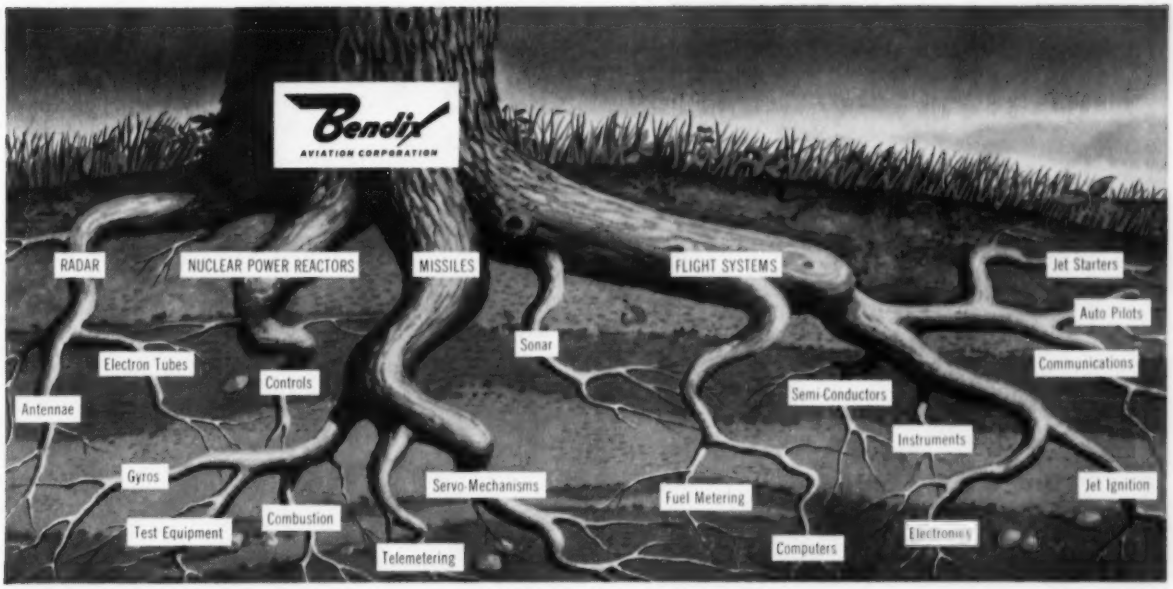

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At Bendix, the emphasis is always on better engineering, more and more research, as evidenced by a $100 million expenditure this year in these phases of the business.

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The broad line of engineering products means broader and more diversified engineering talents are employed here than anywhere else. There is plenty of room to grow, to gain experience and to prosper. And individual divisions are small enough so you won't get "lost in the shuffle".

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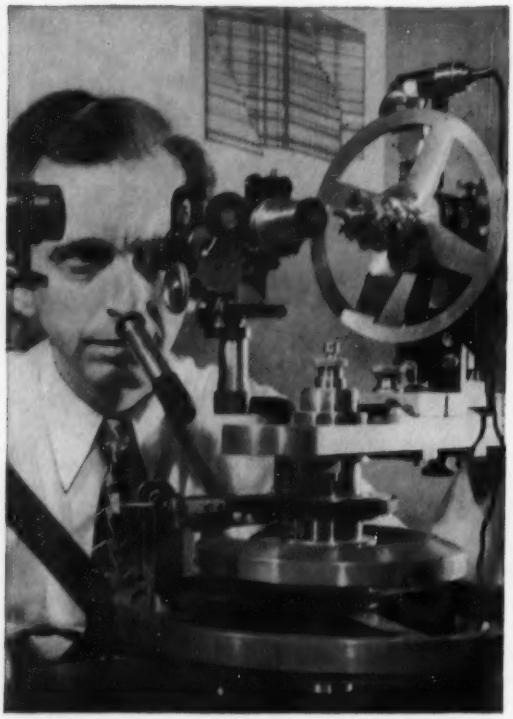

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Letters to the Editor

In the past few years the civil and mechanical engineers have found it great sport to spend the last few minutes before their two o'clock class lounging in front of their respective buildings, Lincoln and Sibley, and watching the co-eds pass in review. In this issue of the CORNELL ENGINEER we are pleased to be able to give you two short verses on behalf of both the co-eds and the engineers. Speaking for the engineers is Stan Whitten, ME '57 and for the co-eds an author who has requested to remain anonymous on the grounds of self-incrimination.

—Editor

Here I sit, an engineer, on Sibley's
East wing stairs
As coeds pass me by, I watch, with
wondering looks and stares
For four long years I've sat there,
with hope perhaps someday
A coed on her way to class will take
my heart away
But four long years I've waited,
four long years in vain
I've sat through blinding snow-
storms, and through the pouring
rain
Experience has taught me, a fact
now tried and true
If there are lovely coeds, they don't
have class at two.

—Stan Whitten M.E. '57

—Jack Warren

STAN WHITTEN

There they sit, the engineers, on
Sibley's east wing stairs
As we walk by they leer at us, with
horrid looks and glares
They bob their heads from left to
right, like at a tennis game.
While one unshaven slide rule kid
remarks, "Wow, catch that
dame'."
Their evil eyes affect us, and makes
our face turn red
The meaning of their awful stare,
in words, need not be said.
The solution for this, coed friends,
who have a class at two
Take every Sibley engineer and put
him in a zoo.

—A coed

Once again the A. F. Davis Undergraduate Welding Award Program is sponsoring their annual writing contest in which students are invited to participate. In the past years Cornell undergraduates have won many times setting up a fine record. To those of you who are interested, don't hesitate to get started right away.

Editor

The American Welding Society will award $700.00 in prizes for the two best articles on welding to appear in undergraduate publications during the current school year. Author of the best article and the student magazine or paper in which it appears will each receive $200.00. Author of the second best article and the publication in which it appears will each receive $150.00.

These awards are made annually by the American Welding Society under the A. F. Davis Undergraduate Welding Award program. Sponsored by A. F. Davis, Vice President and Secretary of the Lincoln Electric Company, Cleveland, Ohio, the program's purpose is to stimulate interest of college students in the art and use of welding.

Articles on any type of welding or its application to design and construction will qualify. To be eligible, the article must be published between April 1, 1955 and June 1, 1956.

—J. G. Magrath
National Secretary
American Welding Society

F. Barrett De Gress ME '57

Founded 1885

Founded 1885

THE CORNELL engineer

DECEMBER, 1955 VOLUME 21 NO. 3

COVER: Winter comes to the campus—

Published monthly—October to May—by the CORNELL ENGINEER, Inc., Lincoln Hall, Ithaca, N. Y. Edited by the undergraduates of the College of Engineering, Cornell University. Entered as second class matter at the Post Office at Ithaca, N. Y., under Section 103, Act of October 3, 1917.

Subscription per year: regular $2.00; with membership in the Cornell Society of Engineers $3.00 (See President's page); student $1.50; single copy $.25.

THE MACKINAC STRAITS BRIDGE

by JOHN M. WALSH, ChemE '59

The Chippewa Indians, the explorers, the trappers, and the founders of St. Ignace and Mackinaw City must have considered at one time or another the possibility of a bridge across the Straits of Mackinac. However, the oldest record of such considerations is found in the February 5, 1884 edition of the *Lansing Republican*. This newspaper stated that since year round ferry service across the Straits had proven not feasible, the only way Mackinaw City and St. Ignace could be connected year round was by a bridge or a tunnel. The connection of these two cities would be necessary if the creation of an east-west transportation route through Michigan were ever to be accomplished.

Aerial photograph looking south toward Mackinaw City shows the foundation piers and main towers. The main piers, shown constructed to a height of 300 feet, will be 552 feet high upon completion.

First Plans Suggested

The proponents of the Mackinac Straits Bridge were offered encouragement in the succeeding few years by the construction of the Firth of Forth Bridge and the Tay Bridge in Scotland, and the Brooklyn Bridge in the United States. It was not until 1920, however, that the Mackinac Bridge was given much additional thought. At this time several plans for crossing the Straits were suggested. Two of these plans were a floating tunnel and a series of causeways and bridges starting eighteen miles from the Straits.

In 1923 the State of Michigan established a ferry service across the Straits of Mackinac, but when the ferries became overcrowded by 1928, attention again turned to the construction of a bridge to carry the traffic. The Michigan State Highway Department made a study of the problem and reported that the bridge could be built for around $30,000,000. The project, however did not meet with much success. Throughout the next few years all attempts to start the bridge were unsuccessful.

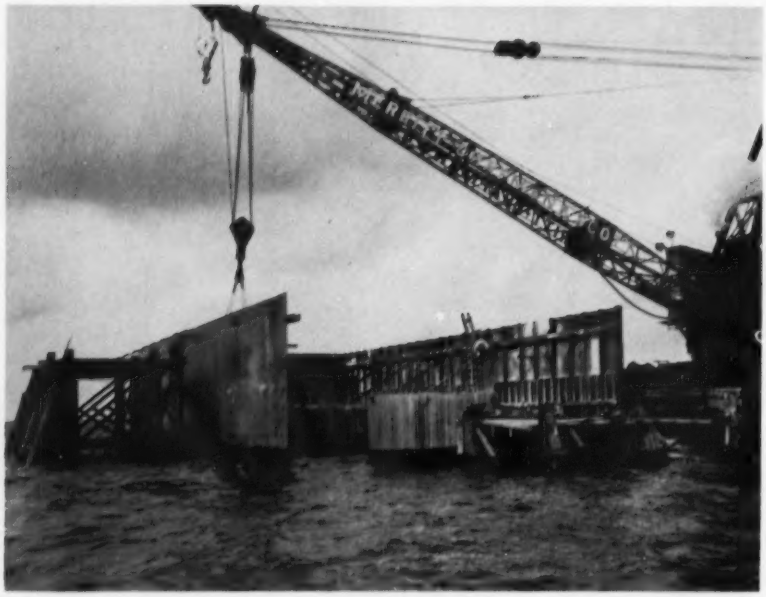
Twenty-one digging wells are shown in a caisson used to construct the foundation of cable piers.

Preliminary Work Completed

By 1940 traffic, geological and other studies had been completed in anticipation of the actual construction of the bridge. An experimental causeway extending into the Straits 4200 feet had been built and preliminary bridge plans had been drawn up. It appeared that the construction of the Mackinac Straits Bridge might soon become a reality. The advent of World War II brought all these preparations to a close. By 1951 preparation for the building of the bridge had been completed and the selling of bonds to finance the bridge was all that remained to be done before actual construction could be started. Not until late in 1953 were all of the necessary bonds sold, however. At this time the construction of the bridge was started by the Merritt-Chapman and Scott Corporation which had been awarded a $25,700,000 agreement to build all of the bridge's foundations and the American Bridge Division of United States Steel Corporation, which had received a $44,500,000 contract to construct the bridge's superstructure. Ceremonies at St. Ignace and Mackinaw City on May 7 and 8, 1954, officially started the construction of the bridge.

Bridge Will Have 33 Piers

Upon completion of construction, the Mackinac Straits Bridge will have thirty-three water based piers for its foundation. Twenty-three of



Pier foundations on which the cables rest before being secured in anchor blocks were constructed with the use of rectangular caissons 130 feet deep, 92 feet long, and 44 feet wide.

the thirty-three piers supporting the bridge are to have their footing on bedrock. The other ten piers will be supported by H-piles driven into bedrock at depths not greater than 174 feet below the surface. The tops of the H-piles will be imbedded in concrete pier bases.

The two deepest piers will be the tower piers which are to be founded 195 feet below the surface. The anchorages for the two supporting cables will be the piers having the largest mass, their bases measuring 135 feet by 115 feet. The piers will extend from 16 to 118 feet above the surface of the water. All in all, the construction of the piers alone will require 438,000 cubic yards of concrete—enough to construct 140 miles of two lane highway—21,000 tons of steel, and 118,000 cubic yards of excavation.

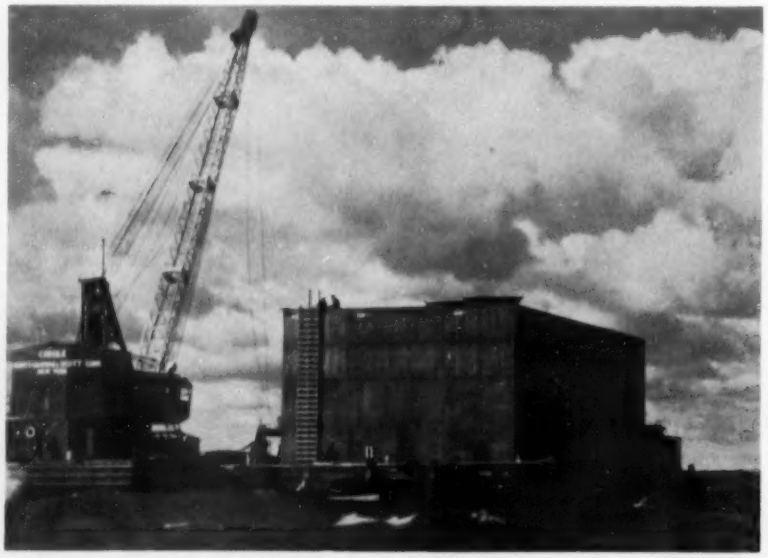
Two Methods of Pier Construction

The two main types of pier construction being used in building the Mackinac Straits Bridge are the cofferdam and caisson methods. Thirty of the bridge's thirty-three piers are being constructed with the use of cofferdams. A cofferdam is a watertight steel enclosure made of sheet-piling and firmly braced to resist pressures exerted by the surrounding water. The piling used is long enough that when it is driven into the rock on which the pier is to be founded, the top of the piling still extends above the water. When the sheet-piling and steel braces are in place, any necessary excavating can be done and the concrete for the pier base can be poured. After the pier base has hardened, the cofferdam can be pumped dry to facilitate further construction operations.

Caissons will be used to construct the other three piers: both tower piers and one cable-rest pier over which the large cables pass before they are secured in the anchorages. Caissons serve the same purpose as cofferdams but can be used at greater depths than cofferdams. Caissons are constructed of steel and/or lumber away from the site of the pier. Open dredge caissons, caissons having open wells extending from top to bottom, are being used to construct the Mackinac Straits Bridge. When the caissons are towed to the pier site the caisson bottom comes to rest on the channel bottom. The caissons are large enough to permit their tops to extend above the surface. The caissons are provided with some buoyancy by a plated bottom around the wells. Excavation is done by means of a digging bucket lowered through the open well in the caisson.

As the excavating proceeds, the bottom of the caisson is gradually filled with cement to make it cut into the channel bottom. The top of the caisson is continually being built up as the cutting edge on the bottom of the caisson bites deeper and deeper into the earth beneath it. When the caisson has been sunk to the desired depth, construction of the pier can be completed. The caissons used on the Mackinac

The caisson for the south cable bent pier was anchored on rock and the rectangular form was cut off eight feet below the surface. Two 18 foot towers were built on the base preparatory to the construction of 90 foot towers above these foundations.



Bridge will range up to 204 feet in height, use as much as 2600 tons of steel, and be sunk through as much as 95 feet of mud and rock.

One of the greatest problems in the use of caissons is sinking them at the exact location desired. In the construction of the Mackinac Straits Bridge, an enclosure made of pipes and H-piles will be used to hold the caissons in position while they are being sunk to the correct depth. This system is better than the usual practice of using concrete anchorages and anchorage cables to position the caisson since there will be less hindrance of navigation. All concreting in the construction of this bridge will be done by the Prepakt method. In this method the enclosure to be concreted is partially filled with gravel and the gravel is then mixed with mortar when the mortar is forced under high pressure through pipes into the gravel. This concreting system will be used in all concreting operations whether under water or not.

To construct the piers for this bridge a $4,000,000 fleet of fifty items of floating equipment will be used. This fleet includes ten derricks; five work boats, used to move the workers from one site to another; five tugs; and twenty material and equipment barges, including: two concreting boats, two welding boats, and two covered cement barges. The derricks will be used for the heavy work, including heavy lifting and pile-driving.

46,000 Miles of Wire to Be Used

Suspended from the towers and anchorages of the bridge will be the two 8,362 foot cables to which the vertical supporting cables will be attached. All in all, 11,500 tons of high carbon steel will be used in the forming of the 46,000 miles of steel wire used in the cables supporting the bridge. The galvanized wire, of approximately pencil thickness is to be shipped to the bridge where it will be formed into the two main cables. All suspender cables will be spun at the place where the wire is drawn. Next, these cables are pre-stressed by being stretched to a tension of 115 tons. This is done to insure that the cables won't stretch when the roadway is suspended from them. Each cable and its button-type socket fixture are capable of withstanding tensions of 235 tons.

The roadway of the bridge is to be constructed of six inches of reinforced concrete topped by a bituminous wearing surface. The roadway will be supported by steel spans up to 560 feet long. For economy, the trusses in the bridge are spaced thirty-four feet apart and the floor beams are cantilevered, i.e. two arms project from opposite sides to bridge the gap. The structural steel in the trusses and other parts of the bridge weighs 50,000 tons.

Bridge Approaches

The approaches for the Mackinac Straits Bridge are divided into three parts. The first section will be a roadway constructed over a previously constructed mole, i.e. a rock-fill construction projecting into a body of water, and a viaduct. From the end of the mole at St. Ignace a four-lane approachway will extend to the bridge toll-collection booths. The third section will be steel beams, topped with concrete and supported by concrete piers. This roadway will have six lanes to take care of traffic overflow.

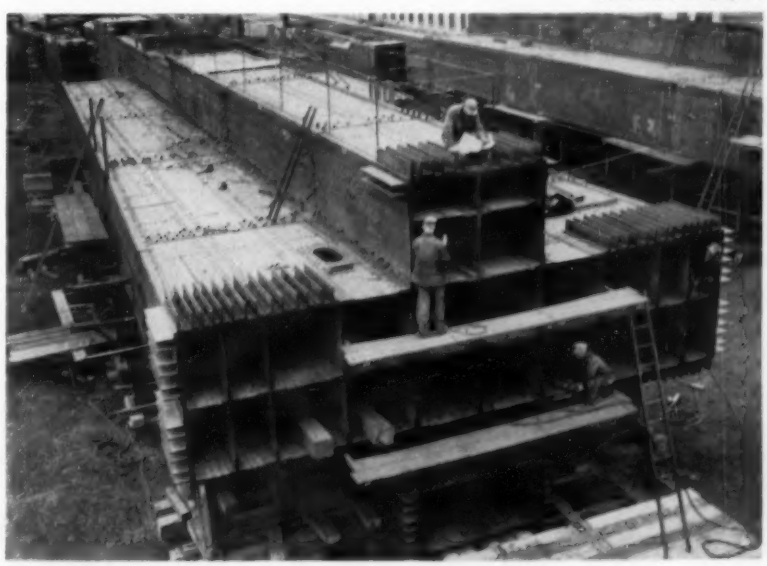
Precautions Against Wind

One of the more interesting features of the design of the Mackinac Straits Bridge is the precautions which have been taken to prevent failure of the bridge in high winds. The stiffening trusses have a depth-length ratio of 1/100 to give added strength. The rigidity of the bridge is increased by having two levels of horizontal braces. Some of the beams have been designed as open trusses, and the cables and beams have been spaced in a manner to provide the least wind resistance. Because of these special features the bridge will be able to withstand winds over 100 miles per hour.

By the end of the 1955 construction season, all foundations and towers for the bridge should be completed. In 1956 the main jobs to be undertaken will be spinning the cables, constructing the Mackinaw City approach, and erecting twelve spans. When, in 1957, the approaches and paving have been completed, the cables have been erected, and the anchorages have been completed, the bridge will be opened to the estimated annual traffic of almost 2,000,000 vehicles. The opening of the Mackinac Straits Bridge will mark the realization of a seventy year, $100,000,000 dream.

Cross-like structure will be part of the base of a 700 ton, 552 foot bridge tower.

—Associated Photographers



The Challenge of Shipbuilding

by W. E. BLEWETT, JR., M.E. '19

The editors believe that Mr. Blewett's article not only provides a realistic insight into the shipbuilding industry, but states a challenge to all who have chosen engineering as their profession. "The Challenge of Shipbuilding" is based upon a commencement address by Mr. Blewett to the 1954 graduates of the Webb Institute of Naval Architecture.

To the best of my knowledge, there is no other industry in the country which has its ups and downs to the degree that the marine industry experiences. In times of emergency, the shipbuilder is very much in demand. Ships, as in the last war, have top priority but when the clouds of war pass, shipbuilding immediately drops to the bottom of the list of importance as far as the nation is concerned. It is a senseless, costly, and short-sighted attitude, but it exists. To give you an example, employment in private and naval shipyards in 1943, during the war, was 1,700,000 and we anticipate that the employment in shipbuilding in both private and Navy yards will reach a low level of a little more than 100,000 in 1955.

Needless for me to tell you, this creates a difficult and unhappy situation in the shipyards. But it also creates a problem that is a challenge. It means a fight for survival. It means using all the ingenuity and skill the naval architect and marine engineer can command to design a ship that will be economical to build, economical to operate, and irresistable for an owner to buy.

As you are aware, the volume of shipbuilding depends to a large degree on Government spending, either directly for Naval vessels or indirectly through so-called subsidies, though I prefer the word tariff, to build and operate our Merchant fleet.

Shipbuilding is dependent, at least at the present time, on the whims of Congress. There are several bills pending before Congress which would help the shipbuilder and the ship-operator but none of these have been made into law. A shipbuilder visits Washington and leaves in a confused state of mind. To illustrate a shipbuilder's attitude in Washington, I was sitting in the Carlton Hotel cocktail bar with a colleague when a man approached him and said, "I'm glad to see you, John. I had a long talk with your brother in Florida." After the stranger left, I said to John, "I didn't know you had a brother." He replied, "I haven't, I just didn't want to argue with him."

If you want an easy life with no worries, don't go into the shipbuilding industry; but if you want an interesting life where you can see the product of your imagination take shape, and that completed product flying an American flag, then shipbuilding is your wise choice. I don't know of anything more satisfying than to have had the responsibility of the design of a vessel, or a part of a vessel, and then to witness its accomplishments on trials.

On the other side of the ledger from the plight of the shipbuilding industry, professionally you are in a broad field of engineering and in working with and about ships, there probably is not a phase of engineering which, sometime or other, you will not be exposed to. You will have to keep informed

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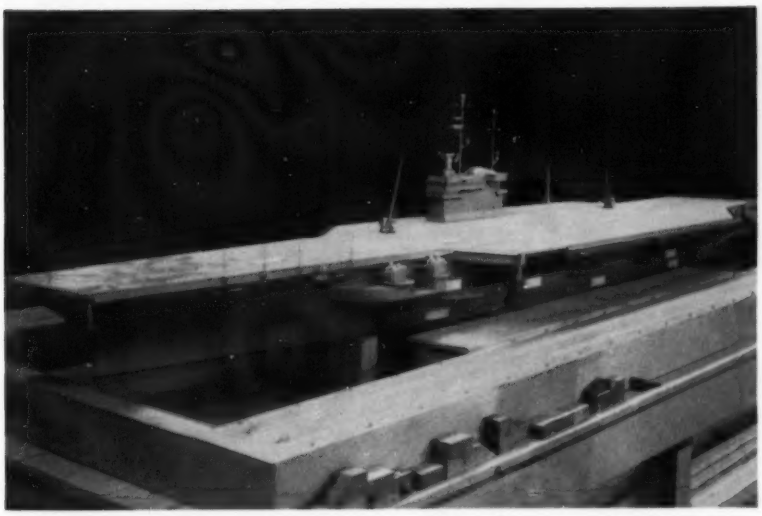
ABOUT THE AUTHOR

Mr. W. E. Blewett, Jr., President of the Newport News Shipbuilding and Dry Dock Company, Newport News, Virginia, is a graduate of Cornell University, Class of 1918, with a Mechanical Engineering degree. Starting in 1919 as a draftsman at the shipyard, Mr. Blewett advanced to the position of Executive Vice President of the Company in 1947. In 1954, he was elected President. Mr. Blewett has been prominent in the shipbuilding industry for many years and has taken an active part in various engineering and shipping organizations. During World War II, he was awarded a Certificate of Merit by the Navy Department for his contribution to the nation's shipbuilding program. Mr. Blewett is a Trustee of the Webb Institute of Naval Architecture at Glen Cove, New York.



A design model of the ship is built as a visual aid in determining engineering, design, and construction problems.

about all engineering developments —different types of propelling machinery, different materials, various techniques for building and if and when we start putting atomic energy into our vessels, the problems that will confront you will be enormous. But that, too, is a challenging prospect.

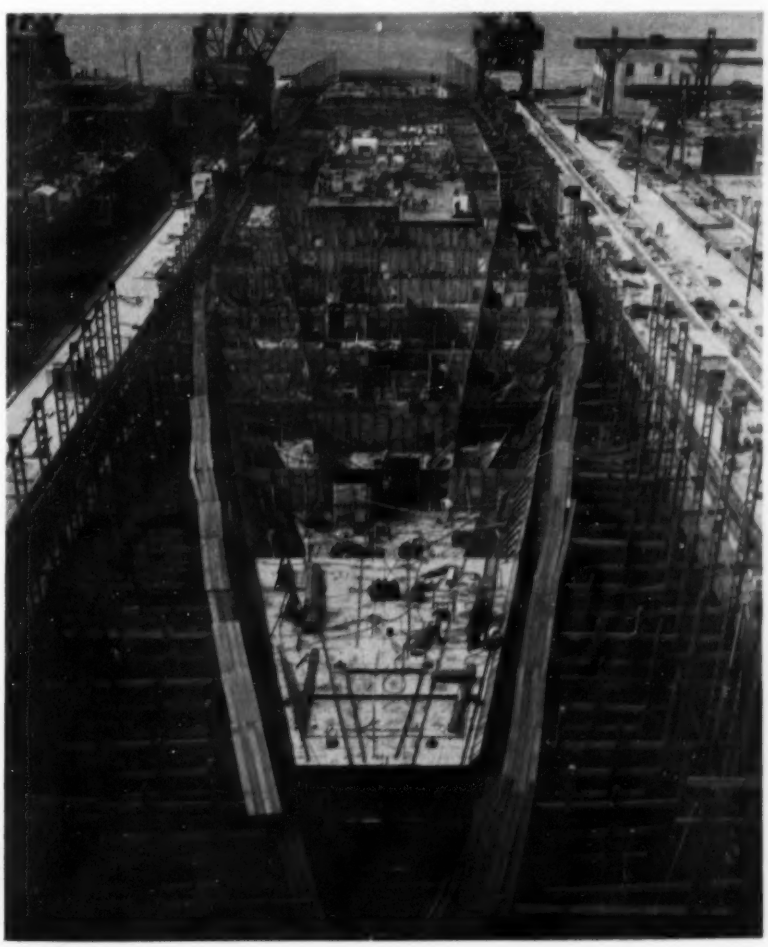
You will be associated with men of high standards and high calibre. There are few promoters or speculators in the industry. It is not lucrative enough! Once in a while speculators will wander into the field, particularly in the time of national emergency, but they soon disappear never to be heard from again.

I should point out that it will be no minor part of your career to deal with labor. As engineers, with the prospect of doing technical work, you may feel that you will not be involved in labor problems, but that is not so. You will find, directly or indirectly, that labor problems are within your sphere. The cooperative relationship between employer and employee, which goes all the way up and down the ranks, is of more than secondary importance. The more skillful you become in the art of getting along with people, without sacrificing any of your principles, the more successful you will be in your job and the more satisfying it will be to you.

Now don't misunderstand me in the somewhat gloomy picture I am forced to paint of the industry outlook today. There will be a lot of work for you to do before you are confronted with the problems that I mention. You may be on the drawing board or in dungarees for a lot longer time than you think you should be with the education that has been given you. But whether in dungarees or on the board, you will be absorbing knowledge. It is a never-ceasing quest and the ability and desire to keep on learning are the most important assets or point of view that a man, young or old, can possess.

The whole field of adapting your engineering knowledge to the dictations of a job lies before you. It may include combatting the whims and fancies, the working knowledge and wider experience of other engineers, some of whom may have better or inferior training than yours. I would like to impress upon you that it is my belief that success in your careers will depend not only on your proficiency as an

View of the construction of the Forrestal about a year and a half after keel laying. At this point the ship is about fifty percent complete.



—Newport News Shipbuilding and Drydock Company

After design of ship and receipt of materials are sufficiently advanced to allow uninterrupted construction, the first keel plates for the vessel are laid.

engineer but also on your adaptability.

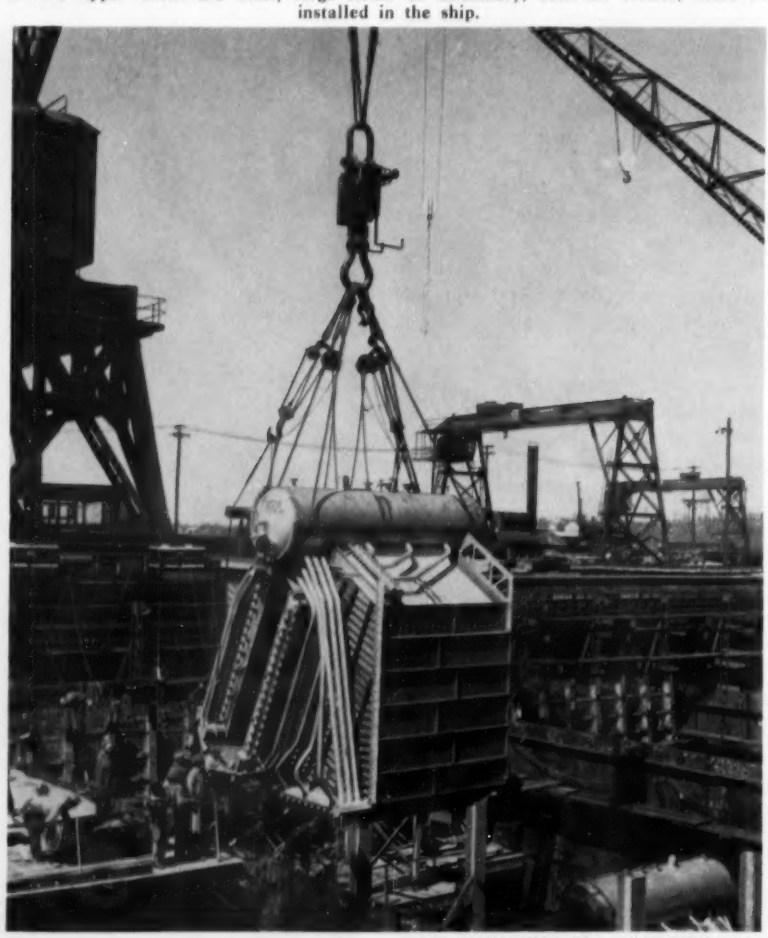
There is a prevalent and erroneous concept floating about that an engineer is apart from all other professional men and that, therefore, he is entitled to be just the least bit queer and odd. Sometimes engineers themselves take refuge in this mistaken idea and thereby contribute less to their jobs, to their development, and fail to assume their full responsibility.

There was never a period in any industry where the well-rounded and technically trained engineer did not have the opportunity to increase his knowledge and prepare for the future. You are the future of shipbuilding. Those of us who have spent our lives in it have weathered many disheartening periods, but at the same time we have made great engineering achievements and we have never failed to meet demands that have been made upon us. There are continuing problems to be met and solved, many of which affect shipbuilding and yet, as I have suggested, are out of the hands of the engineer to solve. We can only hope that the proper authorities will appreciate them immediately and be wise enough to solve them.

Despite the present outlook, which we hope is temporary, shipbuilding itself, one of the oldest industries on record and one with great diversification of work, and one of national and international significance, is on the dawn of great developments. The need for higher speeds, economy of operation, new materials with higher tensile values, factors of safety to be reduced, and, over-all, the ramifications of atomic-powered vessels present problems that must be solved. Possibly the whole art of Naval Architecture and Marine Engineering will be radically changed. It is exciting to speculate about the future and the challenge it will bring to shipbuilding and to the men who design and build ships.

I am certain that all of you want to find a job and get ahead with all possible speed. That attitude is one of the blessings of youth but it is also one that needs tempering, as many of us old youths can testify. Many men hold many ideas about how one gets ahead, succeeds. It is certainly true that the breaks count but it is not fate

Before upper decks are built, large items of machinery, such as boilers, must be installed in the ship.



—Newport News Shipbuilding and Drydock Company

—Newport News Shipbuilding and Drydock Company

Overall view of the 1036 foot Forrestal shortly before christening. Sister ship Ranger, although started in smaller adjacent dock, was moved to larger dock after Forrestal christening.

alone that will reward you. To some degree you can manage to be in the right spot at the right time. I would suggest that since you are now ready to assume more responsibility, your climb up the ladder of success will depend upon how much responsibility you can, and are willing to, assume. Whatever form it takes, it is basic. You cannot be irresponsible in small jobs and responsible in larger ones. It never pays to be too proud to do any job assigned. Looking back on it, I am sure that it never hurt me, a young married man, to spend a Christmas Eve and Christmas Day in the oily tanks of a ship testing for gas—though on Christmas Eve I may not have been exactly philosophical about it!

Your studies here and your practical experience have not taught you all the answers; education teaches you where and how to find answers and presupposes initiative as well as the ability to reason. It does not merely set forth an array of facts to learn, many of which you will doubtless forget. I am certain of one thing and that is that you should not think you know or appear to know so much that there is nothing left for anyone else to know. Graduation occasions are appropriately named when they are called "commencements." You are beginning on another phase of your career now and every promotion or new job is, in a sense, a commencement, with opportunities to learn, as well as to practice the knowledge that you have already gained.

Commencement addresses are traditionally patterned as messages of boundless hope for the future or visions of the world as a gloomy place in which graduates are about to set forth as tenderfoots. Neither of these patterns is my concept as you have seen.

I elect to leave you with the thought that the world is neither better nor worse than it was when other generations graduated into the working ranks. One's future is always bright if one steps smartly.

Wherever you go and whatever work you may do, our good wishes go with you. I hope that you will attach appropriate significance to personal integrity and that you will have lasting pride in doing your jobs well.

Delivered by: W. E. Blewett, Jr., President Newport News Shipbuilding & Dry Dock Company, Newport News, Virginia.—July 17, 1954.

Partial view of Newport News Shipbuilding and Dry Dock Company showing the nation's two largest ships, the SS United States and the U.S.S. Forrestal in the foreground.

—Newport News Shipbuilding and Drydock Company

Engineering Industrial Cooperative Program

by PROF. EVERETT M. STRONG

The Cooperative Plan

There are various plans by which engineering schools and industries cooperate but "the Cooperative Plan" through many years of operation has come to mean specifically a course of study which schedules the student alternately between school and industry during a substantial portion of his undergraduate work. The Plan, however, is not only a schedule providing for alternation; neither is it primarily an "earn-as-you-learn" enterprise although wages ample for subsistence are paid. The Plan is a *concept of education* which recognizes that an engineer cannot be made on a college campus alone; that sometime he must function in the actual environment of industry, and that he can direct his study efforts in school to better advantage when he understands that environment through his own experience in it.

The Plan recognizes further that industry seldom can provide the necessary jobs and supervision when confined to the summer period of college vacation but that when spread with some uniformity around the whole calendar year, industry can and will cooperate with students and schools to carry out a very effective program. This still requires more than scheduling, more than a job; it requires well-organized and cooperative supervision, adequate counseling of students and a firm sense of purpose; it requires cooperation and understanding from top management selection of industries and careful selection of students who have demonstrated qualifications to utilize the greater opportunity and services provided by the Plan.

More often than not, the co-op student discovers that his concept of his intended field of work is in some degree erroneous, unrealistic or over-romaticized and, sometimes, he discovers a downright incompatibility with basic elements of the job. It is well to find this out before he has reached a state of preparation and anticipation that is changed only with major reorientation and the Cooperative Plan has amply demonstrated its effective service to this purpose. The co-op student prepares himself both on campus and in industry with an enriched understanding of purpose which practically eliminates the generally disruptive transition from school to industry and advances by about a year the responsibility he can take and be paid for on graduation.

Shown above is a "breadboard" version of a test panel to be used for testing a fighter gunsight system. Michael DeNicola, E.E. '57 is shown at work with the equipment.

The Cornell Program

The Cornell Engineering Industrial Cooperative Program was initiated in 1947 with the educative objectives just indicated and now has a considerable roll of alumni and a slate of cooperating companies who demonstrate the actual effectiveness of the Plan as operated by Cornell.

Under the joint supervision of school and industry each student is assigned a regular job selected in line with his interests and preparation. He is given responsibility to produce, not merely to observe, although he is encouraged to get

PROF. EVERETT M. STRONG

around , as his job permits, to explore other areas. Sometimes, these explorations are organized and scheduled with opportunity for discussion with managing personnel. Many plants organize orientation meetings, luncheons, or dinners to acquaint the students with company organization, objectives, functioning and key personnel. These often involve cooperative students from other schools and recently hired college graduates. The opportunities for contact with these young men have been found quite as important as the contacts made on campus.

The success of the student in each assignment is recorded both at school and industry. He is measured not alone by technical knowledge and contribution but, even more, by his responses to situations, the effectiveness of his thought and action, and especially by his ability to work with his associates and enlist their constructive cooperation.

Schedule and Courses

The schedule for the Cornell Cooperative Program is an example of simplicity and utilizes the same curriculum of courses pursued by the regular students. Because no students are admitted to the cooperative program until the completion of the second year of their curriculum, the cooperative schedule really begins after the second year. As tabulated below, all cooperative students pursue the same schedule. By utilizing the three summers after the second year, three industrial periods, A, B, C respectively in the Fall, Summer and Spring are provided, totalling one calendar year with *no delay in date of graduation*. Except for the two summers in school, cooperative students are scheduled with their regular classmates whenever on campus.

TABLE 1

Calendar Periods	*Regular School Terms*	*Co-op Terms*
Summer	Vacation	5th term
Fall	5th term	A
Spring	6th term	6th term
Summer	Vacation	B
Fall	7th term	7th term
Spring	8th term	C
Summer	Vacation	8th term
Fall	9th term	9th term
Spring	10th term	10th term

The studies of terms five and eight are taken on campus during the summer. The cooperative summer terms are independent of the University Summer Session, and comprise two successive seven-week periods, each a complete unit usually of three courses. Evening school study on the job is *not required* in the Cornell Cooperative schedule although there is no objection to such pursuit by any student on his own, and some have done so.

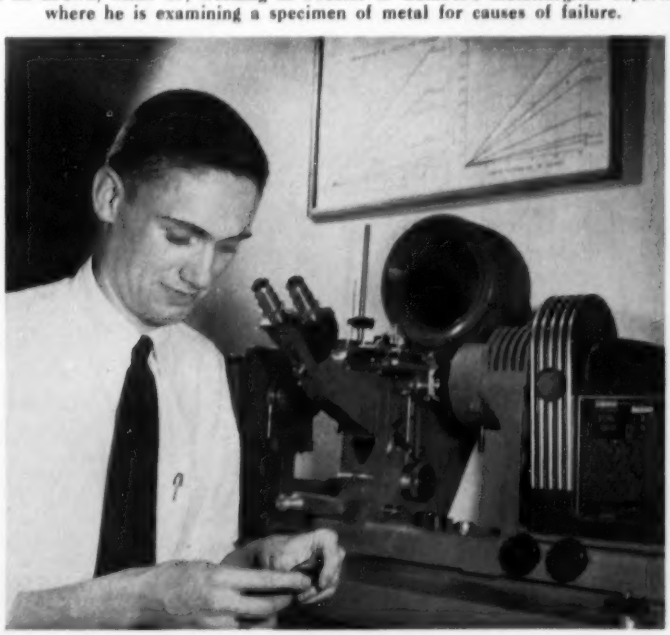
Admission

Admission to the cooperative program is open to selected candidates chosen from the Sophomore class in the regular EE and ME curricula. They must satisfy both the school and the cooperating industry of their scholastic and personal qualifications to pursue the program to a mutually successful conclusion.

The selection is in two steps as follows:

1. By the school — a sound scholastic record to date is required. Grades should be 75 or better; and definitely not below 70. Records in the 70-75 range are admissable only when temporary illness or other extenuating circumstances justify tentative admission pending improved grades.
2. By the cooperating company —a successful interview on campus with the company representative is required. These interviews are similar to those conducted for employment on graduation and purpose to assess the humanistic qualities of the man

David E. Brown, M.E. '57, working in Procter & Gambel's metallurgical department, where he is examining a specimen of metal for causes of failure.



Richard Bennet, E.E. '57 is pictured adjusting an electro-hydraulic actuator in an auto-pilot system.

more than his scholastic aptitudes.

Because the plan visualizes progression of the student in industry from less demanding assignments through to development, research, and other more advanced responsibilities, it is not feasible for any one student to pursue experience in more than one industrial organization. He, therefore, is admitted to the program by arrangement with *one cooperating company* and is in their employ throughout the program. Although the student admitted to the program may not transfer from it without the official sanction of both the school and the cooperating company, neither the student nor the company is obligated in any sense for employment beyond the completion of the program.

Cooperative Industries

In order of their joining the program, these are:

1. Philco Corporation
2. General Electric Company
3. Air Reduction Company
5. American Gas and Electric Service Corporation
6. Cornell Aeronautical Laboratory
7. International Business Machines Corporation
8. Stromberg-Carlson Company
9. Combustion Engineering, Inc.

Each of these is a company of substantial size and provides adequate breadth of operation in its field. Literature from each company is available from the Cooperative Office, 26 West Sibley, describing its activities beyond possible summary here. All companies are open to either mechanical or electrical engineering students. It is to be noted that both Philco and General Electric, although seemingly more identified with electrical products, produce heavily such items as air conditioners, refrigerators, steam and gas turbines, and other essentially non-electric equipment. Furthermore, all manufacturing, even of electrical equipment is primarily mechanical engineering. For example, the design and performance of machinery and factories for the manufacture of such electronic equipment as radar gear, all kinds of electron tubes, and now transistors is a real challenge in high production, high precision techniques.

A number of questions commonly asked about the Cooperative Program may be of interest as follows:

Q. Can R. O. T. C. students join the Cooperative?

A. Yes, many of our students are in the R. O. T. C.; Army, Air Force, and Navy all cooperate to make this possible.

Q. Do industrial periods affect draft status?

A. All co-op students during their industrial periods in the academic year are formally registered in the University as students "in absentia" and retain student status when in industry. R. O. T. C. students also maintain enrollment in R. O. T. C.

Q. Can a co-op student save money on the job?

A. In general, yes. This depends, of course, on his living requirements, ability to manage savings, and, somewhat, on location. Occasionally, a student can live at home for one or two assignments but seldom for all of them. Some students save a third without benefit of overtime pay or living at home.

Q. Isn't study in the summer difficult?

A. Experience has shown that the summer term on campus offers no special hazards either to scholarship or happiness. During most of the summer the social pace is more moderate than in the academic year. Classes are smaller than those in the regular semesters and instruction is of the best with exceptional opportunity for personal contact with some of our best teachers. The two-part schedule by which three of the usual six courses are taken in each seven-week period has found high approval from all concerned. Ithaca summers have an excellent comfort rating.

Q. Does the Cooperative Program interfere with athletics and other activities on campus?

A. *Yes, Sometimes.* Nearly all co-op students, however, do participate considerably in various activities and every effort is mode to avoid unneccesary interference. Several varsity football players have completed the Cooperative Program, and schedules are modified to enable participation in other varsity level sports, or other high level activities. On the other hand, it is to be noted that out in industry many co-op students enjoy the opportunities avail-

able such as basketball, music, and dramatics.

Q. Isn't the pace without summer vacation too strenuous?

A. *The Cooperative Program is not an accelerated program, and formal* book-study is omitted during industrial periods The alternation of periods of formal study and industrial work constitute a very satisfactory change of environment and activity which provides most of the virtues of so-called vacation periods in the regular program. One week made available between each alternation totals three weeks per year which is more vacation time than most post-school jobs provide.

Few students can afford either financially or educationally to regard the 3 month summer vacation periods of college as idle playtime. The important function of vacations is to provide time for the recuperative change in environment and inactivity which forestall "going stale," i.e. working over-long at high level mental tasks.

Q. Isn't a summer job just as good?

A. Summer employment in engineering, of course, varies with the needs of industry. Some students are very successful in finding good engineering jobs during the summer. A few students obtain industrial scholarships which include a summer employment agreement. Industries, however, *do not make a practice of providing a continuity of summer employment comparable with the co-op program* and there is none of the counselling, planning and coordination jointly with school and industry which are unique with the co-op. Considerable preparation and back-stage work goes into providing for the co-op student his entree into the jobs and areas of industry which both school and industry regard as most educative.

Q. Are high grades necessary for admission?

A. Top grades are not required but a healthy scholastic record and outlook are necessary. Grades below 75, either individual or average, are regarded with question, and failed courses with alarm, in appraising the scholastic future of an applicant for the Cooperative Program. The industrial interviewers are concerned especially with personal qualities of applicants, and high scholastic status cannot compensate for inadequate personal appraisal.

Q. Where may I be assigned to work?

A. The locations of the facilities of the participating companies are as follows:

1) *Philco Corporation*—
Largely in and around Philadelphia, Pa.

2) *General Electric Company*—
Centers in Schenectady, N. Y.; other plants elsewhere in New York and in Massachusetts, Connecticut, New Jersey, Pennsylvania, Ohio, Illinois, Wisconsin, Kentucky, Mississippi

3) *Air Reduction Company*—
Research in Murray Hill, N. J.; plants in Union and Bound Brook, N. J.; Chicago, Ill.; Madison, Wisc.; and Louisville, Ky.

4) *The Procter and Gamble Company*—
Cincinnati, Ohio and Staten Island, New York.

5) *American Gas and Electric Service Corporation*—
Headquarters in New York City with plants throughout the Ohio Valley and Appalachians.

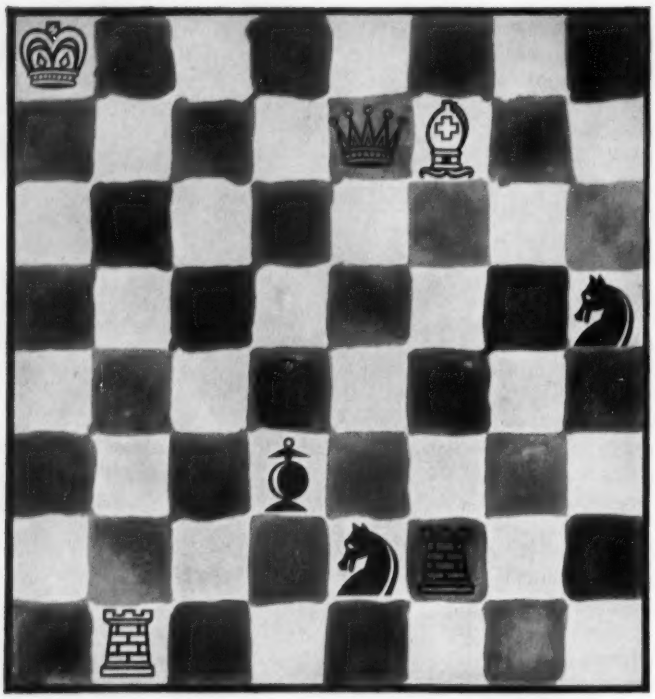
6) *Cornell Aeronautical Labotory*—
Buffalo, N. Y. (This is not a unit of the Graduate School of Aeronautical Engineering).

7) *International Business Machine Corporation*—
Primarily in New York State; research in Poughkeepsie; plants in Poughkeepsie, Kingston, and Endicott.

8) *Stromberg-Carlson Company*—(a division of General Dynamics Corporation) Research and major manufacturing plants at Rochester, N. Y.

9) *Combustion Engineering, Inc.*—
Plants in Chattanooga, Tennessee; East Chicago, Ind.;Chicago, Ill.; Monongahela, Pa.; St. Louis, Mo.

Alan Gast, ME '57 is shown regulating the inlet water flow to a cradle dynamometer which is being used for a performance test on a General Electric pipe line pumping unit.



smart move

There are three jobs for every two engineers in this country. It's an engineer's dream . . . and therein lies a danger.

For this simply means that it's easier than ever before to make a mistake in the company and the job you choose.

If you're wise, you'll realize that the move you make now is possibly the most important in your business life. Hence, you'd do well to look closely into the *management* of any company you're considering. Then take a careful look at the *future* of the job you're offered.

It might be a smart move to look closely at the Martin story—for it's the story of the youngest and most dynamic engineering management group in the aircraft industry today.

Contact your placement officer or J. M. Hollyday. The Martin Company, Baltimore 3, Maryland.

MARTIN
BALTIMORE

THE ALUMINUM INDUSTRY WAS BORN ON SMALLMAN STREET

▼ In 1888, the aluminum industry consisted of one company—located in an unimpressive little building on the east side of Pittsburgh. It was called The Pittsburgh Reduction Company. The men of this company had real engineering abilities and viewed the work to be done with an imagineering eye. But they were much more than that. They were pioneers . . . leaders . . . men of vision.

A lot has happened since 1888. The country . . . the company . . . and the industry have grown up. Ten new territories have become states, for one thing. The total industry now employs more than 1,000,000 people—and the little outfit on Smallman Street? Well, it's a lot bigger, too—and the name has been changed to Alcoa. ALUMINUM COMPANY OF AMERICA . . . but it's still the leader—still the place for engineering "firsts".

As you prepare to trade textbooks for a position in industry, consider the advantages of joining a dynamic company like Alcoa—for real job stability and pleasant working conditions—where good men move up fast through their association with the recognized leaders in the aluminum industry.

Alcoa's new aluminum office building

We have fine positions for college graduate engineers—in our plants, sales offices and research laboratories from coast to coast. These are positions of responsibility in production supervision, plant and design engineering, industrial research or sales engineering. Right now it may be quicker than you think from a seat in the classroom to your career with Alcoa. Why not find out?

Your Placement Director will be glad to make an appointment for you with our personnel representative. Or just send us an application yourself. ALUMINUM COMPANY OF AMERICA, 1825 Alcoa Bldg., Pittsburgh 19, Pa.

ALCOA ALUMINUM

ALUMINUM COMPANY OF AMERICA

BRAIN TEASERS

Last month, we printed a problem consisting of a "jumble" of verbal propositions concerning men, mathematician, whiskey, and Mozart. The problem, which we are about to solve below, happens (as our readers probably discovered) to be *most* difficult to solve verbally. It bears some similarity to certain other subjects such as income-tax law, computer circuitry, and census-statistics.

The problem is easily solvable by use of Boolean Algebra, and we had something up our sleeve, in giving the problem in the first place. This time, we will kill two birds with one stone by first displaying some Boolean Algebra for solving the Mathematician problem, and then causing next month's problems to be such as to yield to the same treatment.

Define:

& = and
* = or
1 = true
0 = false

Thus, X & Y means X and Y, etc.

Define:

p, q, r, s, . . X, Y, Z . . = symbols, each of which represents a statement of membership in a "class", and is always therefore either true or else false.

Thus, X = "he likes whiskey" is a statement, and Y = "he likes Mozart" is another statement.

If we want to say that it is false that he likes whiskey and Mozart, both, we write:

$$(X \,\&\, Y) = 0$$

Define:

$$X' = \text{not } X$$

For example, if X, as above, says that "he" belongs to the class of objects whose common quality is a liking for whiskey, then X′ says that "he" is a member of another class whose common quality is NON-membership in the class denoted by X.

There are a number of basic rules similar, with some exceptions, to rules of ordinary algebra, and these basic rules are listed below. (Not all are immediately obvious, but perhaps readers can justify them after sufficient brooding).

(Idempotent law)

$$X * X = X$$
$$X \,\&\, X = X$$

(Intersection)

$$0 \,\&\, X = 0$$
$$1 \,\&\, X = X$$

(Union)

$$0 * X = X$$
$$1 * X = 1$$

(Complementation)

$$X \,\&\, X' = 0$$
$$X * X' = 1$$

(Involution)

$$(X')' = X$$

(Commutation)

$$X * Y = Y * X$$
$$X \,\&\, Y = Y \,\&\, X$$

(Association)

$$X * (Y * Z) = (X * Y) * Z$$
$$X \,\&\, (Y \,\&\, Z) = (X \,\&\, Y) \,\&\, Z$$

(Distribution)

$$X * (Y \,\&\, Z) = (X * Y) \,\&\, (X * Z)$$
$$X \,\&\, (Y * Z) = (X \,\&\, Y) * (X \,\&\, Z)$$

and

$$(X \,\&\, Y)' = X' * Y'$$
$$(X * Y)' = X' \,\&\, Y'$$

If X implies Y, this may be expressed as

$$X \,\&\, Y' = 0$$

Now we proceed to translate problem 3 of last month into symbolic form:

let p = He is a mathematician
q = He likes Mozart
r = He has to wait 20 minutes for a bus
s = He likes whiskey
0 = false
1 = true
& = and
* = or

There were four propositions, each of which is here stated first verbally and then symbolically.

(1) "If a mathematician does not have to wait 20 minutes for a bus, then he either likes Mozart or else whiskey, but not both."

$$p \,\&\, r' \,\&\, \Big\{(q \,\&\, s') * (q' \,\&\, s)\Big\}' = 0$$

$$p \,\&\, r' \,\&\, \Big\{(q' * s) \,\&\, (q * s')\Big\} = 0$$

(2) "If a man likes whiskey, then he either likes Mozart and does not have to wait 20 minutes for a bus, or, he does not like Mozart and has to wait 20 minutes for a bus, or else he is not a mathematician."

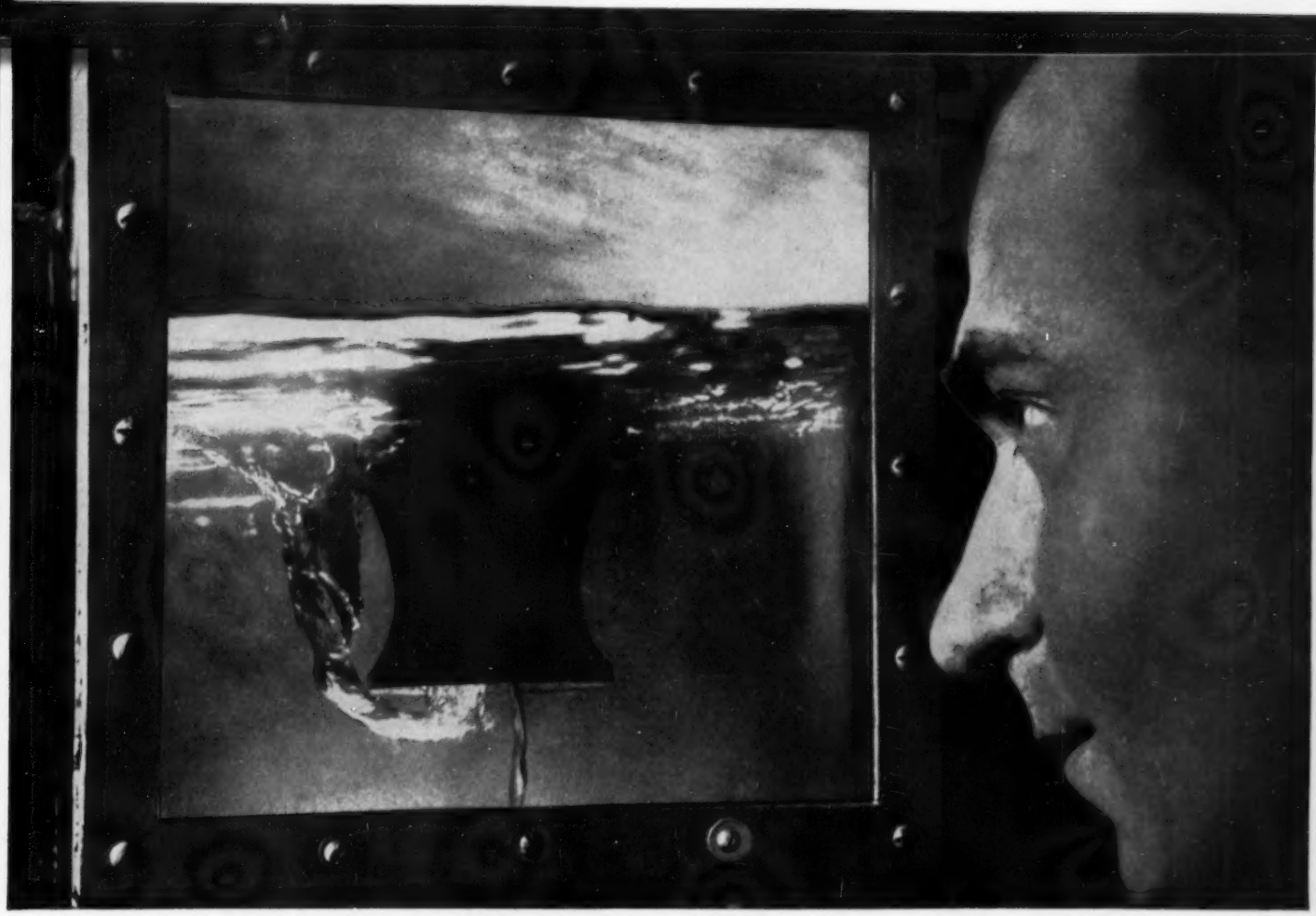
$$s \,\&\, \Big\{(A \,\&\, p) * (A' \,\&\, p')\Big\}' = 0$$

where

$$A = (q \,\&\, r') * (q' \,\&\, r)$$

and

$$A' = (q' * r) \,\&\, (q * r')$$
$$= (q' \,\&\, r') * (q \,\&\, r)$$



A WHIRLPOOL SPIRALS into the inlet of a model pump. This unique picture shows how air, a common cause of pumping trouble, was carried into the pump in . . .

The Case of the Baffled Whirlpool

Some time ago, the report reached us that two Worthington vertical turbine pumps installed by one of our customers weren't working right. They delivered plenty of water, but vibrated badly and burned out bearings.

The customer asked us to find the trouble fast. After checking we knew the pumps were okay, so Worthington Research had to answer him.

First thing we did was build a one-tenth scale model of the customer's installation. The photo shows what happened when we started pumping.

A whirlpool immediately formed between the water surface and the pump inlet. Air, trapped in the whirlpool and carried into the pump, was the villain in the case.

The solution came with experimentation. A simple baffle arrangement in a side channel eliminated the whirlpool—and the trouble-making air.

Chasing the gremlins from pump installations like this, boosting the efficiency of heat transfer in air conditioners, developing better seals for pumps and compressors — these are all in the day's work for Worthington's busy research engineers. At Worthington, research ranks right alongside engineering, production, and sales to develop better products for all industry.

For the complete story of how you can fit into the Worthington picture, write F. F. Thompson, Mgr., Personnel & Training, Worthington Corporation, Harrison, New Jersey. 4.25C

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LIQUID METERS • MECHANICAL POWER TRANSMISSION • PUMPS • STEAM CONDENSERS • STEAM-JET EJECTORS • STEAM TURBINES • WELDING POSITIONERS

$$s \,\&\, \left\{ \left\{ (p \,\&\, q \,\&\, r') * (p \,\&\, q' \,\&\, r) \right\} * \left\{ (p' \,\&\, q' \,\&\, r') * (p' \,\&\, q \,\&\, r) \right\}' \right\}' = 0$$

(3) "If a man likes Mozart and does not have to wait 20 minutes for a bus, then he likes whiskey."

$$q \,\&\, r' \,\&\, s' = 0$$

(4) "If a mathematician likes Mozart, he either likes whiskey or has to wait 20 minutes for a bus; conversely, if he likes whiskey and has to wait 20 minutes for a bus, he is not a mathematician if he likes Mozart."

$$(p \,\&\, q \,\&\, s \,\&\, r) * (p \,\&\, q \,\&\, s' \,\&\, r') = 0$$

Now, applying the "rules" listed above, and substituting into the propositions the following:

$p = 1$ (since he *is* a mathematician) Therefore $p' = 0$

and

$r = 1$ (he has to wait 20 minutes for a bus), $r' = 0$

we obtain from the propositions

(1) $0 = 0$

(2) $s \,\&\, (q')' = 0$ (Note that $(q') = q$), $s * q' = 0$

(3) $0 = 0$

(4) $q \,\&\, s = 0$

$s' * q' = 1$

Therefore, the verbal answer to last month's question 3 is: A mathematician must wait 20 minutes for a bus provided he likes neither whiskey nor Mozart.

We trust that this explanation of Boolean Algebra is sufficiently "complete" for our purposes. Two of next month's three problems (No. 1 and No. 3) may be solved by applying the same rules used for the mathematician problem, so keep this handy.

One more remark: We'll welcome suggestions, complaints, and, above all, more new problems for Brain Teasers, so if you have time drop us a letter. Here are December's problems. Sender of the earliest postmarked correct solution to No. 3 will receive three dollars remuneration and the solution will be published. Answers to 1 and 2, pg. 60.

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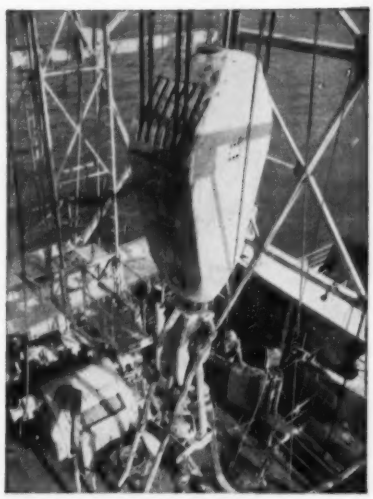
1. As a column of soldiers marched along a road a messenger started from the rear on horseback with a speed three times that of the column. The messenger reached the front of the column and then returned to the rear. Where in relation to the original position of the column did he meet the rear?

2. A product is shipped in a rectangular box whose edges are 3, 4, and 5 inches long respectively. As part of an advertising plan, two opposite corners of the box, most remotely separated from each other, are to be connected by a continuous line drawn on the outside surface of the box. What is the length in inches of the shortest possible line that will do this?

3. Suppose the two hands of a clock are interchanged in their positions. Usually, this will not give a position corresponding to any actual time but there will be some positions where the interchanged position again gives a reasonable reading. How many such positions exist?

Another page for **YOUR BEARING NOTEBOOK**



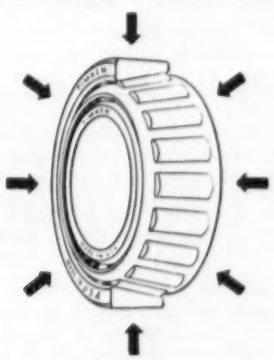
How to tackle heavy thrust loads in a 400-ton traveling block

Fleet angles set up a thrust problem on this oil rig traveling block. Engineers solved it by mounting the sheaves on Timken® tapered roller bearings. They keep the sheaves in positive alignment regardless of the fleet angle or line load, give the 400-ton capacity block maximum stability.

Timken bearings are designed to roll true, and precision-made to live up to their design. As a result, sheaves rotate freely and easily, even with a full weight of drill string, reducing line slippage and wear.

The taper in TIMKEN® bearings lets them take radial and thrust loads in any combination

Timken bearings are tapered to take thrust loads as well as radial loads, or any combination. And Timken bearings can handle heavy loads because (1) they have full line contact between rollers and races. And (2) the rollers and races have shock-resistant cores under hard, wear-resistant surfaces.



Want to learn more about bearings or job opportunities?

Some of the engineering problems you'll face after graduation will involve bearing applications. For help in learning more about bearings, write for the 270-page General Information Manual on Timken bearings. And for information about the excellent job opportunities at the Timken Company, write for a copy of "This is Timken". The Timken Roller Bearing Company, Canton 6, O.

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TAPERED ROLLER BEARINGS

NOT JUST A BALL ○ NOT JUST A ROLLER ⬭ THE TIMKEN TAPERED ROLLER ⬭
BEARING TAKES RADIAL ⟠ AND THRUST ⟜ LOADS OR ANY COMBINATION ✳

CORNELL SOCIETY OF ENGINEERS

William M. Leonard

"The objects of this Society are to promote the welfare of the College of Engineering at Cornell University, its graduates, and former students and to establish closer relationship between the college and the alumni."

It has been a lot of years since I went through the mill at Cornell but there are some angles that I remember.

For instance, there were times when the subject at hand got into a tough phase and my social and sports schedule was cancelled out because I had to spend extra hours at skull practice instead. During these periods, I suppose it was natural for me to dream of the wonderful days to come after I had my sheepskin and the magic initials after my name.

My dream of the glories to come was the college student's version of the song the school kids sing when vacation begins . . . no more pencils, no more books, no more teacher's dirty looks.

For me, I thought, life would really commence on Commencement Day, I would take my place in the world as an important and distinguished person. To any Doubting Thomas, it would be sufficient to wave my magic sheepskin which proved that I was an educated man, an engineer. To the world of affairs I would say bring on your bridges, your seaways, your industrial problems—Leonard, the Cornell Graduate is here.

In my dreams I did not neglect the trimmings—the big money, fancy office, short hours, and the national prestige I was destined to enjoy.

What actually happened, of course, was quite different, as it is going to be for you. As a graduate engineer, I was treated with respect when I applied for work but none of my prospective employers went so far as to hang out the flag and ring the bells. The man about to graduate with an engineering degree is a big man on the campus, I found, but on the outside he finds himself low man on industry's totem pole.

College, even Cornell, doesn't turn out the finished engineer. Its function is to provide the engineer with his basic tools. When you take your first job on the outside you, the graduate engineer, may first be a little surprised and hurt to find your new employer intends to expose you to a fairly-long training period of his own. However, you won't be on the payroll a week before you realize that the waters outside really run deep.

During your last year on the campus you will feel like a relatively old man and your words will have weight in the fraternity house. Two hours on that new outside job will slice a good many years from that feeling of maturity. You'll be the junior of the crowd and it may be some time before some of the older men get around to asking your opinion.

However, that is the way we all cross the bridge between our college and professional lives. We suffer a swift transition from self-assurance on the campus to a feeling of deflation when we first go on the job. But, please don't think I am assuming the role of crepe-hanger. Before long you will find yourself and realize that it is right, just, natural and intellectually sound for all good men to begin at the bottom of the heap and really learn their trade. I know it used to help me to remember that the big boss in the corner office began in exactly the same manner. Moreover, he spent the first hour on his first job on a vain errand for a left-handed payzant pen.

A year after graduation, you will find the sun is shining. You will have spent the daylight hours of that year over a drafting table or the equivalent. You will have spent the evening hours wondering whether your budget would stand a new pair of shoes or if the girlfriend will settle once again for a neighborhood movie and a Coke. You're still at the bottom of the ladder of your organization or pretty close to it. But two wonderful things will have happened to change it all.

First: you get a raise. The number of dollars won't be much or important. But that raise is a great, big dazzling sign that says to you, "You're making the grade, kid; we hope you stick around."

That raise is a symbol of the fact that you're an engineer for sure now and not just a guy fresh out of school.

Second: a couple of guys who are fresh out of school are put on the payroll. They will look awfully young and green to you. A little scared, too. But, one of the established gang goes over to them, introduces himself and gives them a word of hope and cheer. It is you, the Old Pro, himself!

W. M. Leonard
Pres. Cornell Society of Engineers

ALUMNI ENGINEERS

Bruce W. Hackstaff, C.E. '31, is vice-president and director of plant and production of The F. & M. Schaefer Brewing Co., Brooklyn. Before joining Schaefer in 1950, he was for seventeen years chief project engineer for Max B. Miller & Co., Inc., supervising the design, erection, and operation of lubricating oil refineries throughout the world. He is the son of the late **Frederick W. Hackstaff '05.**

Ellis K. Locher, M.E. '32, has been promoted to assistant manager of the Central region of Ethyl Corp., with headquarters in Chicago, Ill. An employee of the company for nineteen years, he has been acting district manager of the safety department in Los Angeles since 1952.

William F. Robinson, C.E. '41 was appointed head of the technical department, Baltimore Refinery, Esso Standard Oil Co., last December. He and Mrs. Robinson **(Margery Huber) '41** live in Baltimore at 627 Regester Avenue.

Joseph L. Boyer, C.E. '42, is sales manager for Unit Structures, Inc., manufacturers of glued laminated wood structures, Peshtigo, Wis. He lives at 1716 Seventh Street, Menominee, Mich.

William D. Wood, M.E. '44, has been named sales engineers in the Washington, D. C., office of the Solar Aircraft Co.

Wood was with General Electric Company at Fitchburg, Mass., for seven years before coming to Solar. He was supervisor of turbine supercharger sales for the small steam turbine and supercharger department. While at Cornell he was a member of ATMOS engineering society, and is now a member of the American Society of Mechanical Engineers. Mr. Wood is married and has three children.

Solar, with plants in San Diego and Des Moines, are leading manufacturers of jet and piston aircraft engine parts, small gas turbines, aircraft and industrial bellows and expansion joints, high temperature ceramic coatings, afterburners, and a variety of other products made of stainless alloys for high temperature use.

Edward Turner M. E. '48

Edward Turner, M.E. '48, has been promoted by the Gardner Board & Carton Co., Middletown, Chio, from technical supervisor of its Lockland (Ohio) paperboard mill to superintendent of its Middletown carton plant. Joining the company in 1950 as a management trainee, he was promoted to staff assistant in the technical department in 1952 and to chemist in 1953. He became technical supervisor of the Lockland paperboard mill in March, 1954. He is the son of the late **Edward T. Turner '10.**

Clarence A. Snider, C.E. '91, Class secretary of '91, died at his home, 100 Montgomery Circle, New Rochelle, on Sept. 5, 1955. He was the retired president and director of Sulphur Export Corp., New York City; was a director of Peabody Engineering Corp. Brothers, **Warner G. Snider '04, Howard L. Snider '08.** Delta Kappa Epsilon.

Frederick Davis Herbert, M.E. '97, died at his home, 24 Norwood Avenue, Upper Montclair, N. J., on August 4, 1955. He was founder and president of Kearfott Co., Inc., makers of airplane instruments and electro-mechanical components. He gave more than $65,000 for construction of Kimball & Thurston Halls for the College of Engineering; had been a member of the University Council since it was organized. Son, **Wilbur F. Herbert '42,** Sigma Chi.

Arthur L. Frost, M.E. '09, 1805 Washington Street, Wilmington, Del., retired last July as manager of the industrial division of Atlas Powder Co. He joined the company in 1941, after eleven years as assistant general manager of Sargent & Co., New Haven, Conn.

Lauriston S. Taylor, M.E. '27, of the National Bureau of Standards has been presented the Henry Harrington Janeway Award for outstanding accomplishments in the field of applications of penetrating radiations in medical science. Mr. Taylor is Chief of the NBS Atomic and Radiation Physics Division.

The Janeway Medal, given annually by the American Radium Society, was presented following a lecture on March 15 in which Mr. Taylor spoke on radiation protection education with particular reference to the possibility of legislative control of radiation sources. In the award, Mr. Taylor was cited for participation in the development of the NBS radiation physics program, contributions toward the development of international standards for radiation protection and radiation units, and leadership in radiation protection through chairmanship of the National Committee on Radiation Protection in this country.

At NBS Mr. Taylor is responsible for direction of the research programs covering atomic and nuclear constants, electron physics, mass spectrometry, spectroscopy, radioactivity, X-rays, nucleonic instrumentation, high-voltage generators and accelerators such as the betatron and synchrotron, and the evaluation of radiation hazards and protective measures.

Before coming to the Bureau in 1927 Mr. Taylor worked briefly at the Bell Telephone Laboratories. In 1941, he was designated Chief of the NBS X-ray Section and, concurrently, Chief of the Field Test Section of the Ordnance Development Division. From May 1943 to January 1946 he was Chief of the Operational Research Division of the 9th Air Force. In recognition of this service he was awarded the

Bronze Star and the Medal of Freedom. In 1948-49 he served for a year as Chief of the Biophysics Branch of the AEC Division of Biology and Medicine. In 1949 he was made Chief of the Radiation Physics Laboratory at NBS, and assumed his present position in 1951. Mr. Taylor received the Sylvanus Thompson Medal from the British Institute of Radiology in 1950.

He has contributed extensively to scientific journals in the fields of X-rays and radiology and is co-author of the book "Physical Foundations of Radiology." He has been associate editor of "Radiology." He has been associate editor of the "American Journal of Roentgenology" since 1930, and atomic physics editor of "Radiology" since 1931. For 22 years, Mr. Taylor was American representative on the International Commission on Radiation Protection and permanent Secretary of the

International Commission on Radiological Units, meanwhile representing NBS on all similar international and national committees.

In 1933 he was selected as chairman of the ICRU. Mr. Taylor is also an associate fellow of the American College of Radiology and a fellow of the American Physical Society, a member of the Washington Academy of Medicine, American Roentgen Ray Society, Radiological Society of North America, Washington Academy of Sciences, Radiation Research Society, and Sigma Xi. He is an Honorary Member of the Deutch Roentgengesellschaft.

Gerald D. Mallory, M.E. '23, left, head of textile research, Goodyear Tire & Rubber Company, received from P. W. Litchfield, chairman of the board of Goodyear, the Litchfield Special Award of Merit gold medal, in recognition of his work and that of P. W. Drew, manager of fabric design, in developing the company's triple-tempering process for tire cord, which made the Goodyear tubeless tire possible. This marked the first time the twenty-seven year old award has been given for a joint research achievement and only the sixth time it has been presented for technical accomplishments. Mallory joined Goodyear in 1925 and was appointed to his present position in 1930. He is married and has one daughter, Patricia. Address: 1709 Goodyear Boulevard, Akron, Ohio.

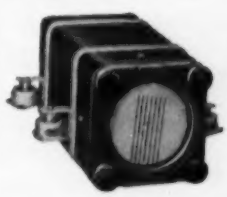
New RCA Radar "Weather Eye" Sees Through Storms

In our time, Man has won round after round in a contest against the elements that started thousands of years ago.

The most recent scientific victory is something new in Radar—an electronic "Weather Eye" developed by RCA.

In airplanes, this supersensitive instrument peers miles ahead. It gives advance warning of weather disturbances. The signals on its radar screen point the way to a safe course *around* storm areas, or even *through* them.

The leadership in electronic research that made the "Weather Eye" possible is inherent in all RCA products and services. And at the David Sarnoff Research Center of RCA, Princeton, N. J., scientists are continually at work to extend the frontiers of "Electronics for Living."

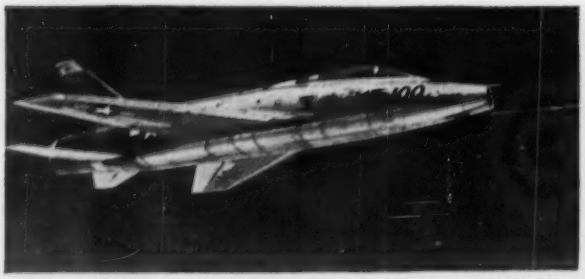


New RCA Weather Mapping Radar weighs under 125 pounds, takes little space in a plane.

For information regarding design and development engineering positions on such projects as "Weather Eye" Radar and military electronic equipment—write to Mr. Robert Haklisch, Manager College Relations, Radio Corporation of America, Camden 2, N. J.

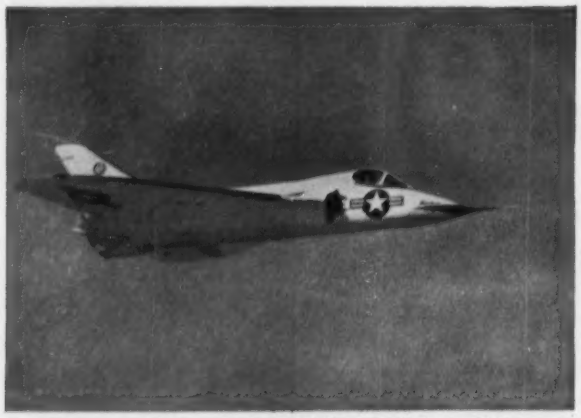
RCA® **RADIO CORPORATION OF AMERICA**

ELECTRONICS FOR LIVING



North American's F-100 Super Sabre, fastest Air Force jet fighter, is powered by Pratt & Whitney Aircraft's J-57 engine.

First all-jet heavy U. S. Air Force bombers are the huge Boeing B-52s, powered by eight J-57s mounted in pairs.



The Douglas F4D Skyray, fastest Navy jet fighter, will be powered with the big J-57 engine.

The Douglas A3D, the Navy's most powerful carrier-based attack airplane, has two J-57 engines.

Blazing the Way for a New Generation of Air Power

The most powerful turbojet engine in production is blazing the way for a whole new generation of American aircraft.

That engine is Pratt & Whitney Aircraft's J-57, the first turbojet to achieve an official rating in the 10,000-pound thrust class.

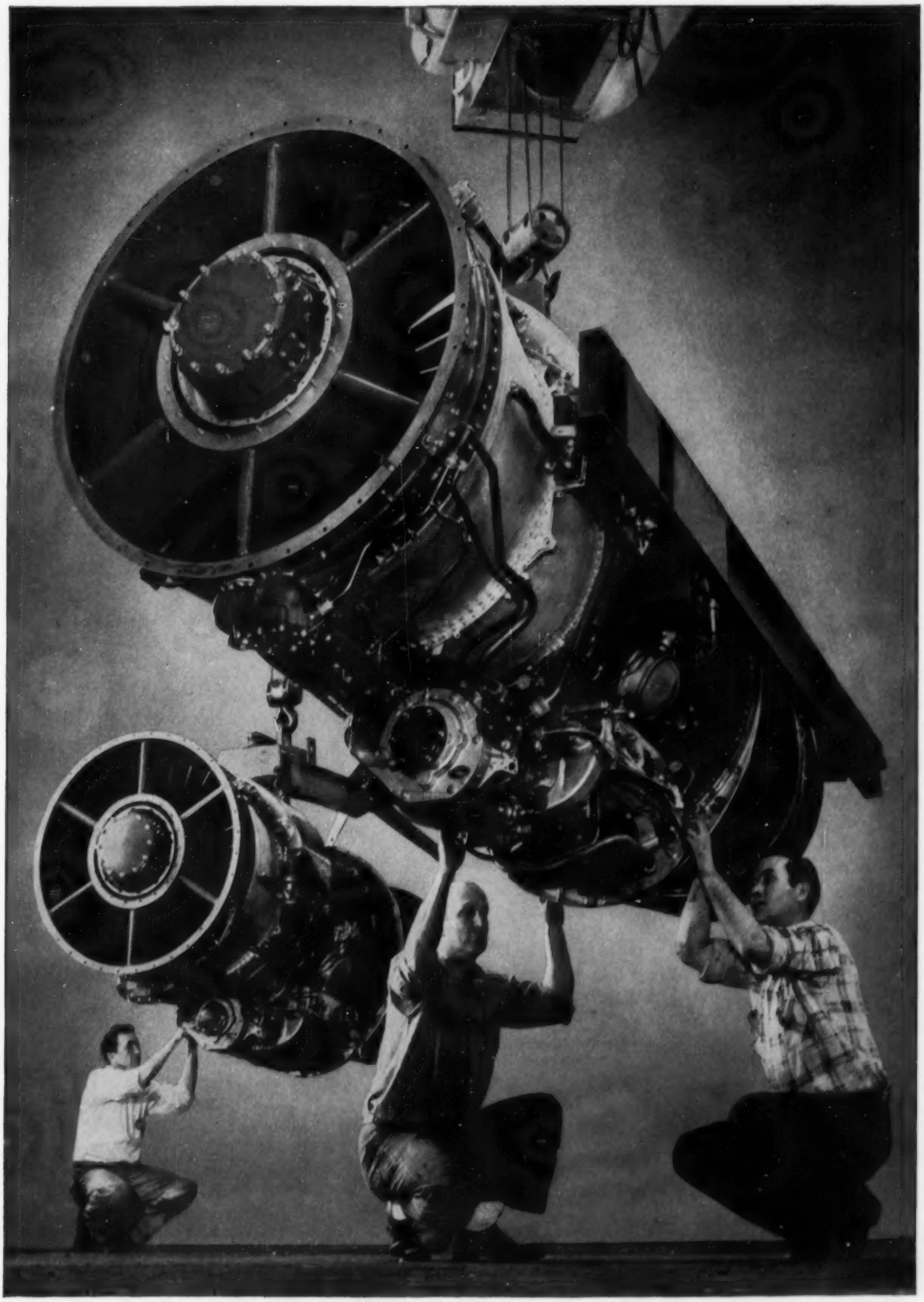
But the J-57 provides far more than extreme high thrust. Its unique Pratt & Whitney Aircraft design, achieved after years of intensive research and engineering, offers as well the low specific fuel consumption so vital to jet-powered bombers and future transports, plus the additional important factor of fast acceleration.

The importance of the J-57 in America's air power program is clearly shown by the fact that it is the power plant for three of the new "century series" fighters for the U. S. Air Force—North American's F-100, McDonnell's F-101 and Convair's F-102—as well as Boeing's B-52 heavy bomber. The Navy, too, has chosen the J-57 for its most powerful attack aircraft, the Douglas A3D, the Douglas F4D fighter and for the Chance Vought F8U day fighter. And the J-57 will power the Boeing 707 jet transport.

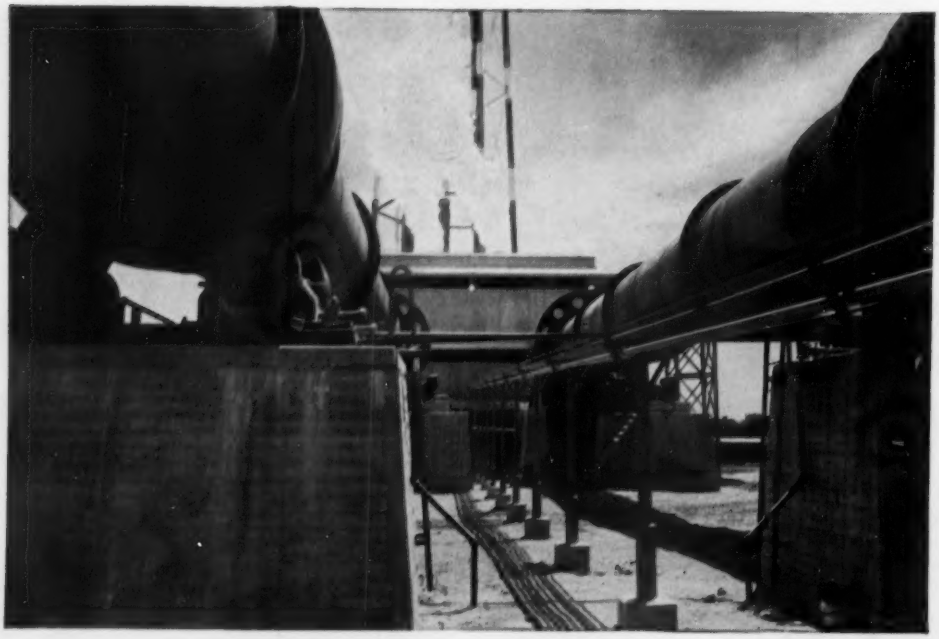
The J-57 is fully justifying the long years and intensive effort required for its development, providing pace-setting performance for a new generation of American aircraft.

Engineering graduates who can see the challenge in this new generation, might well consider a career with the world's foremost designer and builder of aircraft engines.

PRATT & WHITNEY AIRCRAFT
DIVISION OF UNITED AIRCRAFT CORPORATION
EAST HARTFORD 8, CONNECTICUT



The J-57, in the 10,000-pound thrust class, is the most powerful turbojet engine now in production. A new generation of U.S. air power has been designed around this mighty new Pratt & Whitney Aircraft engine.



CONSTRUCTION— Tremendous rotary kilns, like these, typify Allis-Chalmers role in the cement industry.

Join the company that serves 3 GROWTH INDUSTRIES

Match your engineering talents to the future needs of the construction, power and manufacturing industries. These are growing needs—for the population is climbing at the amazing rate of 50,000 people every *week!*

Many billions of dollars for highway *construction* alone are called for by the President in the next ten years. Allis-Chalmers builds equipment used in making cement, aggregate and steel as well as earth movers and graders.

Electric *power generation* will double in ten years. A-C builds the machines that make electricity.

Manufacturing output must increase $3.5 billion by this time next year. Allis-Chalmers builds motors, control, drives and many other types of equipment for this industry.

MANUFACTURING— A-C aids high speed production and helps improve quality with dielectric sand core dryers like the one above.

POWER GENERATION— Growing use for power means growing demand for A-C steam turbines, transformers, and other equipment.

Here's what Allis-Chalmers offers to Young Engineers:

A graduate training course that has been a model for industry since 1904. You have access to many fields of engineering: electric power, hydraulics, atomic energy, ore processing.

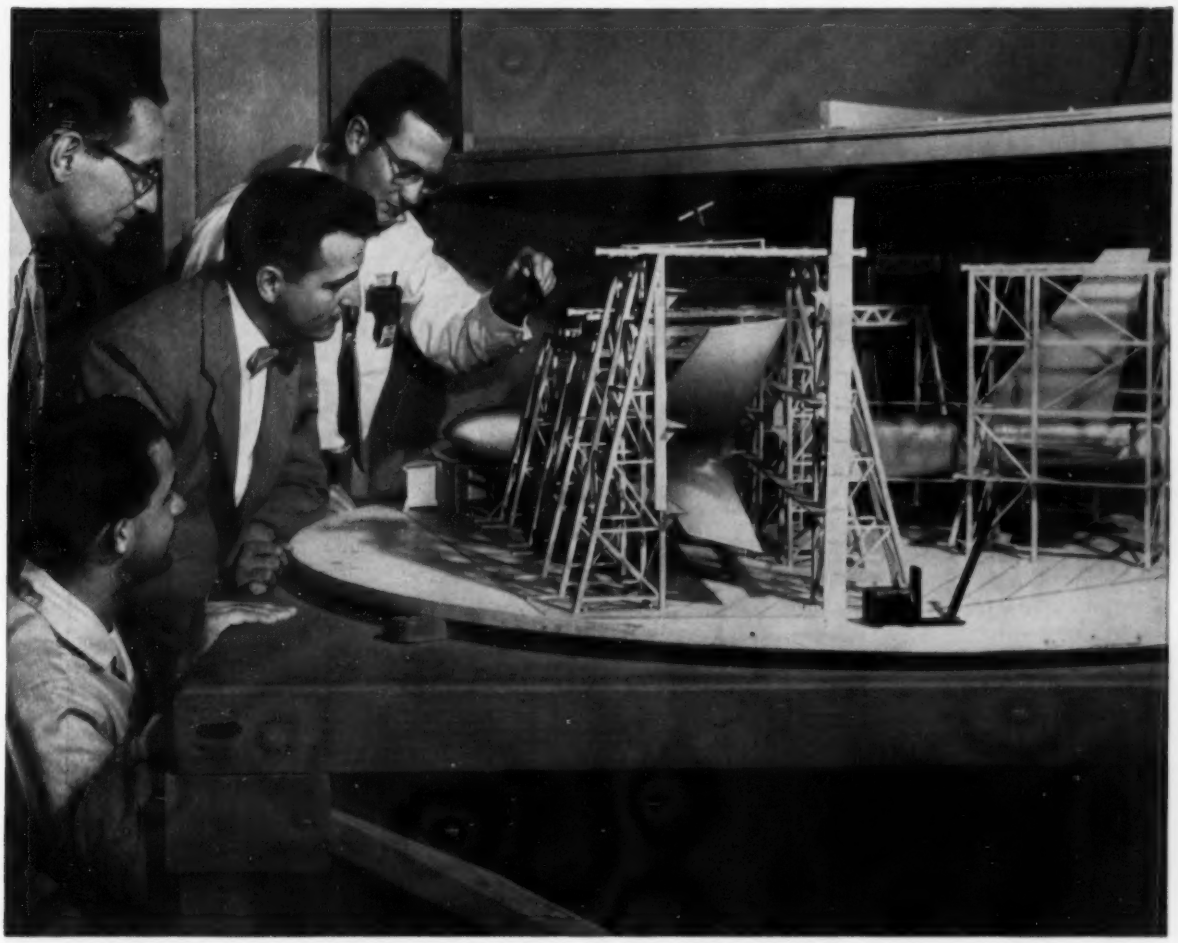
There are many *kinds* of work to try: Design engineering, application, research, manufacturing, sales. Over 90 training stations are available, with expert guidance when you want it. Your future is as big as your ability can make it.

Or, if you have decided your field of interest and are well qualified, opportunities exist for direct assignments on our engineering staff.

In any case—learn more about Allis-Chalmers. Ask the A-C manager in your territory, or write direct to Allis-Chalmers, Graduate Training Section, Milwaukee 1, Wisconsin.

ALLIS-CHALMERS

A-4685



Boeing engineers work with stimulating associates

Many engineering skills are represented in this picture. Mechanical, civil, electrical and aeronautical engineers—in almost equal proportion—work closely together in planning and conducting the structural test of airplanes such as the B-52. This stimulating contact among experts in every field is typical of Boeing projects. It makes a good engineer even better, and helps his professional growth.

In no other industry does the engineer have the opportunity to evaluate so completely—through destruction testing—the structural integrity of such a large and complex product. It is a "classical" challenge for mechanical and civil engineers. It tests the instrumentation ingenuity of electrical engineers and gives aeronautical engineers an opportunity to proof check designs by translating theoretical air loads into practical test loads.

Many immediate problems and "years ahead" projects involving these same skills and their infinite variations are under way at Boeing. The application of rocket, ram-jet and nuclear power to current and future aircraft and missiles is typical of projects in active study. Applied research in developing materials and components to withstand the tremendous heat and stress of flight at supersonic speeds offers even further opportunities to express engineering talent.

More than twice as many engineers are with Boeing now than at the peak of World War II—evidence of the company's solid growth. This outstanding group of engineers has been responsible for such aviation landmarks as the 707 Stratoliner jet transport and its KC-135 military tanker version, the Bomarc IM-99 guided missile, the global B-52 jet bomber and the B-47 jet bomber, present backbone of Strategic Air Command.

Graduates of top engineering schools all over the country come to Boeing. If you, too, want breadth of contacts, job variety and professional growth, it will pay you to investigate Boeing. There is always room for additional creative engineers on Boeing's research, design and production teams.

For further Boeing career information consult your Placement Office or write the Boeing plant nearest you:

JOHN C. SANDERS, Staff Engineer—Personnel
Boeing Airplane Company, Seattle 14, Wash.

RAYMOND J. B. HOFFMAN, Admin. Engineer
Boeing Airplane Company, Wichita, Kansas

BOEING

Aviation leadership since 1916

College News

The School of Chemical Engineering has tentatively proposed a plan for new option of electives for those who want to apply their chemical engineering to the food, fermentation, or biochemical industries. Included in this sequence are two new courses: Specialized Unit Operations, and Fermentation Engineering, which will be offered in alternate years. The sequence will start in the seventh term with Biochemistry 101, in the College of Agriculture. The four remaining courses: Specialized Unit Operations, Bacteriology 6, Industrial Micro-organisms, and Fermentation Engineering, will follow through the tenth term. This option has been initiated under the direction of Prof. R. K. Finn.

CE Display of Modern

The Department of Structural Engineering of Cornell's School of Civil Engineering cooperated with the Andrew Dickson White Museum of Art in bringing to the campus an exhibition entitled "Structure and Space in Contemporary Engineering," shown at the museum from November 9-30.

The exhibition demonstrated how new structural materials have been used in novel methods of construction by contemporary engineers and architects. Each of its five sections stressed a different solution to problems of structural design.

One is the arch-rib system of construction, whose tradition goes back to the Middle Ages, but which has been adapted to the new possibilities offered by steel and reinforced concrete. Another is on the thin-shell construction method, an application of reinforced concrete.

Reinforced concrete appeared again, in a spectacular demonstration of its possibilities, in examples of sports arenas based on cantilever construction, with no other support than the design and strength of the material.

The fourth section covered the revolutionary concepts of Konrad Wachsmann and R. Buckminster Fuller, in which solid support is reduced to a minimum of bulk and with maximum efficiency. The final section explored the possibilities of suspended steel structures in constructions other than bridges.

The exhibition came from the Museum of Modern Art.

David DeGroat 21-year-old honor student at Cornell University, (left) is congratulated by Maxwell E. Hannum, NAM education director, on winning the National Association of Manufacturer's first annual Eastern Division scholarship. Looking on is Charles R. Burrows, director of Cornell's School of Electrical Engineering.

Burrows Named In IRE

Charles R. Burrows, director of the School of Electrical Engineering at Cornell, has been elected Regional Director of the Institute of Radio Engineers. The area covers all of New England and New York State, except New York City.

Dr. Burrows has been a member of the Committee on Radio Wave Propagation of the I.R.E. since it was formed and has been chairman three times.

He has been vice-chairman and chairman of the U.S. National Committee of the International Scientific Radio Union and headed the U.S. delegation to the union's General Assembly in Sydney, Australia.

He was international president of Commission II on Tropospheric Propagation of the International Scientific Radio Union, and president of the Joint Commission on Radio Meterology of the International Council of Scientific Unions. He is vice-president of the International Scientific Radio Union.

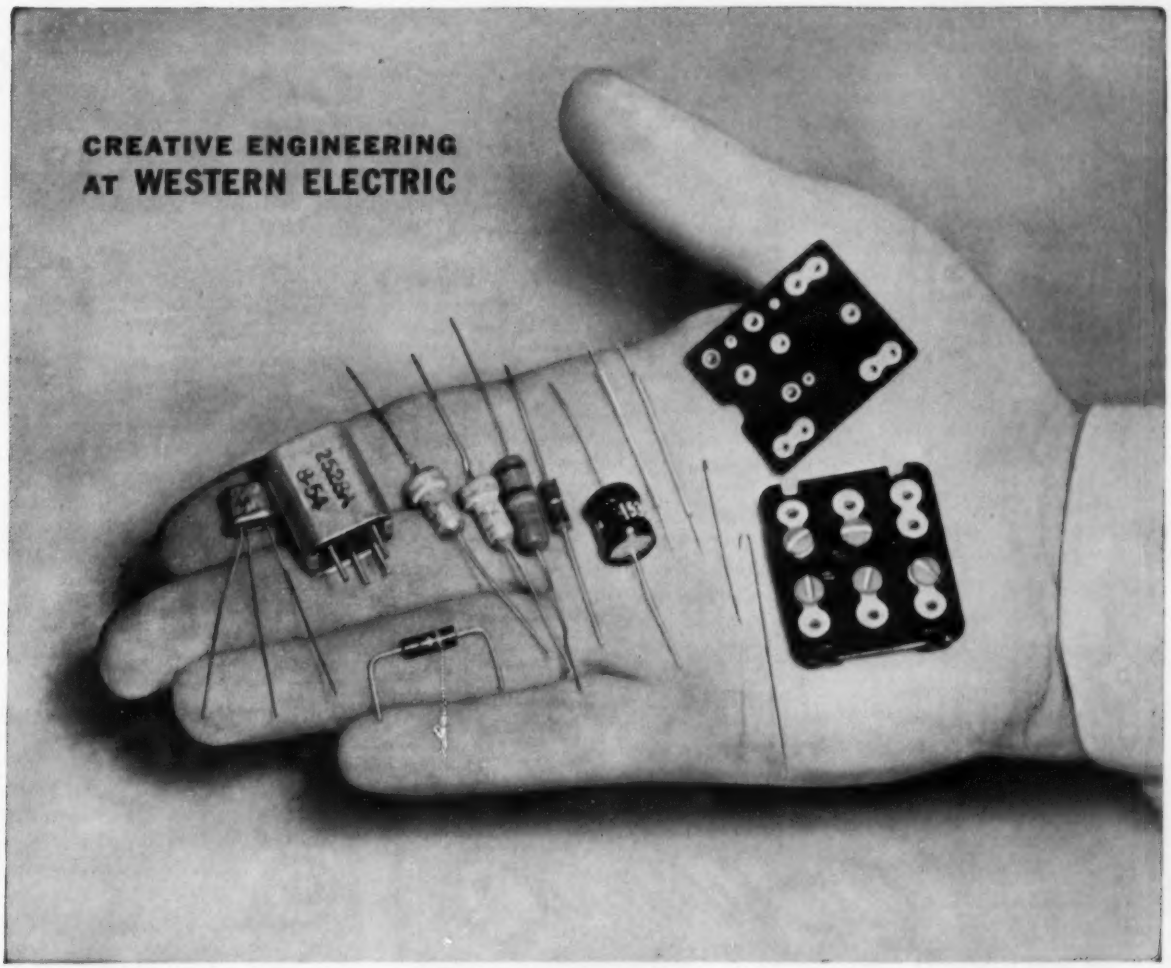
Dr. Burrows has just returned from a symposium on Radio Astronomy held at the Jodrell Bank Experimental Station of the University of Manchester under the auspices of the International Astronomical Union. Dr. Burrows has been actively involved in the School of Electrical Engineering's research on radio astronomy.

Electronics Center

Cornell University and the General Electric Company announced plans for expansion of GE's Advanced Electronics Center at Cornell University Airport. A second story housing 3600 square feet will be added to the existing Cornell building in a construction program to be finished April 1, 1956.

The new facilities will be occupied by laboratories and offices needed in the Center's research and development programs for the armed services.

Walter Hausz, manager of the GE installation, announced today, "GE is proud to be a part of the growing economy of the Ithaca area. The Advanced Electronics



Use of the transistor in Bell telephones

Shown here are the parts of the small amplifying unit in Western Electric's new Volume Control Telephone.

Because of the use of a transistor (shown above, extreme left on index finger) this amplifying unit is no larger than an ice cube and can fit inside the housing of a standard telephone.

Manufacturing of transistors on a commercial basis represents a solid engineering achievement... for it means volume production of an item that must be made under rigidly controlled laboratory conditions. For example, harmful impurity atoms in the germanium must be reduced to less than 1 for every 10,000,000,000 germanium atoms and then helpful impurity atoms added until there is approximately 1 for every 50,000,000 germanium atoms.

Western Electric has been making transistors since 1951 when our engineers set up the first commercial production line. This history-making achievement is representative of the way we work as the manufacturing unit of the Bell System... translating Bell System designs and inventions into the many things—from tiny semi-conductors to huge switching systems—used in the nationwide Bell telephone network.

It's a job that presents an unending challenge to our engineering staff.

VOLUME CONTROL TELEPHONE: A twist of control knob increases listening volume... a boon to those who have difficulty hearing.

Western Electric

MANUFACTURING AND SUPPLY UNIT OF THE BELL SYSTEM

Manufacturing plants in Chicago, Ill.; Kearny, N. J.; Baltimore, Md.; Indianapolis, Ind.; Allentown and Laureldale, Pa.; Burlington, Greensboro and Winston-Salem, N. C.; Buffalo, N. Y.; Haverhill and Lawrence, Mass.; Lincoln, Neb.; St. Paul and Duluth, Minn. Distributing Centers in 29 cities and Installation headquarters in 15 cities. Company headquarters, 195 Broadway, New York City

Center, with its 15 special laboratories equipped for work on a number of electronic study programs, has steadily grown in space and personnel requirements since establishment in Ithaca at the Cornell University Airport in November 1951."

Approximately 2100 square feet of the addition's space will be taken up by laboratories, with engineering offices to occupy 1500 square feet.

Projects at the Center include experimentation with magnetic devices, transistor development, automation, and simulation systems. The "systems" concept includes study of an assortment of electronic and mechanical equipment joined together for performance of a task.

Systems now undergoing study and development at the Advanced Electronics Center include radar, air defense, countermeasures, communications network and navigation.

Morse Hall Demolition

Demolition of Morse Hall began Monday (December 5) at Cornell University.

Originally a four-story chemistry laboratory, the building was nearly destroyed by fire in 1916. The two floors remaining were roofed over and have continued in use until this year.

Vice President John E. Burton explained that opening of the new engineering building on the south campus had freed enough space to permit the long-contemplated razing.

The hall is named for Samuel F. B. Morse, with whom Ezra Cornell worked on the early telegraph. The south section was built in 1890, the north one eight years later. A west wing, joining the two, was built in 1911 with a gift from Andrew Carnegie.

Most recently, the building has housed the painting and sculpture division of the College of Architecture, which has moved to Franklin Hall, and units of the Department of Speech and Drama, now in Rand Hall.

The engineering divisions which occupied Franklin and Rand Halls have been transferred to the new engineering quadrangle.

To Cornell's first president, Andrew Dickson White, construction of Morse Hall on the promontory along Fall Creek Gorge was a "sad mistake." White's autobiography protests that the decision was made during his absence in Europe.

"That site," he declared, "afforded one of the most beautiful views in our own or any other country." The building "might better have been placed elsewhere."

Supersonic Studies

Cornell Aeronautical Laboratory announced that its research program for the U. S. Air Force on the North American F-100 Super Sabre would include studies at faster-than-sound speeds in a range where measurements on the airplane had never before been taken.

The F-100, the Air Force's first operational supersonic fighter and the latest addition to the nation's air arm, will receive more than 100 hours of flight testing by the laboratory's Flight Research Department.

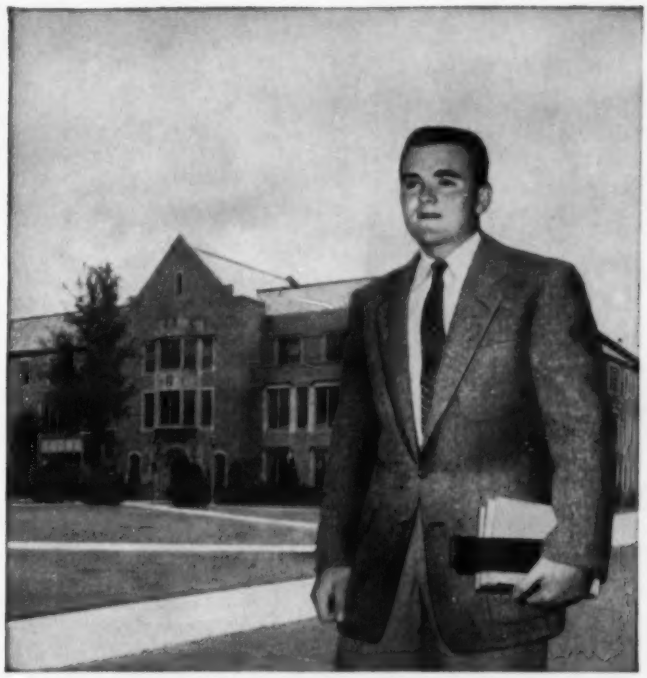
Technically described, "The F-100 program aims at the complete flight determination of the longitudinal and lateral stability derivatives for a fighter over Mach number (speed) ranges for which these data are not in existence," William Milliken, head of the department, said. "The difficulties of this sort of measurement cannot be over-exaggerated."

The stability program will check previous calculators of engineers based on wind tunnel and other studies. The program includes flights below, at, and slightly above the speed of sound. Cornell's project is sponsored by the Wright Air Development Center, U.S.A.F.

The jet fighter has been at the Laboratory's hangar for instrumentation for several months. It will be flown to Edwards Air Force Base, California, for flight testing this spring. Cornell Chief Pilot John C. Seal and Pilot Robert Watts will do the actual flying. About ten Laboratory personnel will be on the west coast during the project.

John Kennedy asks:

How much travel is there in technical sales work?



JOHN T. KENNEDY is working toward his B.S. degree in chemical engineering from Notre Dame University in June 1957. He's a member of the student branch of A.I.Ch.E. and is active in the Young Christian Students and in the Chicago Club. Because John feels one should make employment plans early, he's starting his investigations during his junior year.

A. HICKS LAWRENCE, JR., earned his B.E. degree from Yale in June 1940 and joined Du Pont in the following month as an analytical chemist. He progressed steadily at various plants, from line foreman to shift supervisor to senior supervisor. In 1949 he applied his technical training to sales work. Today Mr. Lawrence is a sales manager in the "Kinetic" Division of Du Pont's Organic Chemicals Department.

A. Hicks Lawrence answers:

Well, John, as the *Old Man of the Sea* told Sinbad the Sailor, "The quantity of travel varies with the specific situation encountered." Of course, you'll never be shipwrecked or encounter the other travel problems that Sinbad did, but a man shouldn't seriously consider a career in sales work unless he really enjoys travel. Most of our sales personnel do just that, because the work itself provides so many rewards and satisfactions. It's not unusual for a representative to be away from home base 30 to 60 per cent of the time.

You see, John, for a good salesman, every trip means meeting new people, new situations, and new challenges. Every one of these offers a chance to display individual initiative. Perhaps the customer will need technical advice on applying our product to a specific item he's developing. The Du Pont salesman may choose to use his own experience and "trouble-shoot" on the spot. On the other hand, he may refer the problem to "home base," where he knows he'll be backed up by a strong technical organization. This knowledge naturally stimulates a salesman and heightens his interest in his work. He knows that he never travels alone.

WANT TO KNOW MORE about technical sales at Du Pont? Send for "The Du Pont Company and the College Graduate." This booklet contains a section on sales work and also gives many interesting details about the technical staff and laboratory facilities which stand behind a salesman. Write to E. I. du Pont de Nemours & Co. (Inc.), 2521 Nemours Building, Wilmington 98, Delaware.

DU PONT

REG. U. S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING . . . *THROUGH CHEMISTRY*

WATCH "DU PONT CAVALCADE THEATER" ON TV

CAL Anniversary

Cornell Aeronautical Laboratory began the celebration of its Tenth Anniversary November 30. Highlight of the three-day event will be the dedication of a recently completed $1,2500,000 building program on the Genesee St. site of the Laboratory.

The schedule of events includes an Employees' Family Day Tour on Wednesday, November 30, from 5 p.m. to 10 p.m.; a Board of Directors meeting Thursday, December 1, and Dedication Day Ceremonies, Friday, December 2. A list of distinguished guests, including top Defense Department men and armed forces officials, as well as industrial leaders, has been invited to attend.

Dr. Clifford C. Furnas, former Director of C.A.L. and presently Chancellor of the University of Buffalo, will be principal speaker at the dedication ceremonies. Dr. Furnas will be named shortly to the post of Assistant Secretary of Defense in charge of the nation's research program.

Completion of the building program—a two-story, 28,000 square foot addition and a three-story, 70,000 square foot new building—marks the uniting of all but one of C.A.L.'s departments. Previously, three technical departments were located on Cayuga Road two miles away. Only the Flight Research Department, which must have access to airport runways, presently remains at that location.

Cornell Aeronautical Laboratory, Inc., is a self-supporting affiliate of Cornell University dedicated to research in the aeronautical sciences. The Laboratory is on not-for-profit status, turning its earned fees toward further research or educational benefits.

At the time that Curtiss-Wright Corporation, original owner of the Laboratory, gave the Research Laboratory to Cornell University, on December 31, 1945, Dr. Furnas termed the enterprise "an experiment in research."

More than 400 of the nation's leading engineers and scientists are engaged in research at the Laboratory. About 95 percent of Laboratory work is for the government, most of it classified. The technical program is extremely broad and includes not only fields directly applicable to aeronautics but related ones.

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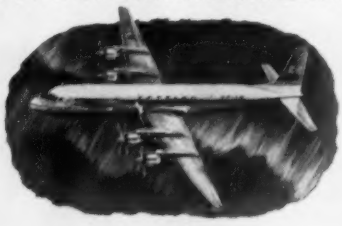

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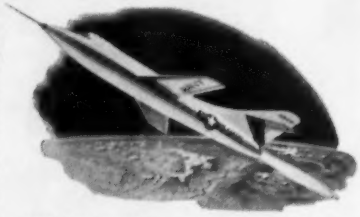

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For further information relative to employment opportunities at the Santa Monica, El Segundo and Long Beach, California divisions and the Tulsa, Oklahoma division, write today to:

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3000 Ocean Park Blvd.... Santa Monica, California

Below decks on the Forrestal...

The U.S.S. Forrestal, world's largest warship, being edged into her berth at the Newport News Shipbuilding & Dry Dock Company for fitting out following christening ceremonies.

Statistics on the size and striking power of the 60,000 ton U.S.S. Forrestal literally stupefy a mind used to normal notions. No torpedo yet invented can penetrate her toughened hull. Her flight deck, almost a quarter of a mile long, will handle the fastest jet planes . . . and is welded into a single sheet of steel, with 5-inch gun batteries mounted on each quarter. At full complement, her crew will number 3500.

Below decks, there's a 200,000-horsepower power plant, capable of lighting a city of one and a half million people. And here, serving on the superheated steam lines, are Grinnell Engineered Pipe Hangers.

Aboard Navy vessels, it's not unusual to meet piping temperatures as high as 900° F., at pressures of 1000 psi. Piping under these conditions, of course, is subject to drastic thermal expansion, and absolutely demands support that is both constant and *flexible*. Without it, the piping could easily rip loose from its moorings, and "walk" all over the place.

Grinnell, backed by a century of practical piping experience, is skilled in every type of installation. Grinnell facilities include research, design, and application engineering, as well as world-wide distribution and unequaled manufacturing capacity. No wonder Grinnell is called upon to supply pipe hangers and supports for all types of installations—*everywhere*. On *your* next piping job, it will pay you to consult a Grinnell engineer.

PIPE HANGERS by GRINNELL

GRINNELL MODEL L CONSTANT-SUPPORT HANGERS maintain full safety factor in high temperature, high pressure systems. Two physical structures accommodate maximum travel requirements of 2½ and 5 inches. 12 spring sizes cover numerous load ranges between 141 and 7,875 pounds.

GRINNELL PRE-ENGINEERED SPRING HANGERS—maximum variation in supporting force per ½" of deflection is 10½% of rated capacity—in all sizes. 18 sizes available from stock—load range from 53 pounds to 12,000 pounds.

GRINNELL VIBRATION CONTROL AND SWAY BRACES—dampen vibration, oppose pipe sway and absorb shock. 3 sizes give full deflection forces from 200 to 1800 lbs.; have initial precompressed spring forces from 50 to 450 lbs. respectively.

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ENGINEERING GRADUATES HAVE FOUND ATTRACTIVE OPPORTUNITIES WITH GRINNELL

Technibriefs

Silent Heart Valve

Physiological inertness and permanent resilience have made silicone rubber a highly promising construction material for a substitute valve proposed for use in the human heart.

Developed by a group under Dr. Stanley J. Sarnoff of the National Heart Institute, Bethesda, Md., the valve is a simple ball-check unit made up of a molded Silastic case and an acrylic plastic ball. Designed to relieve aortic stenosis, a malfunctioning of the heart's main outlet valve frequently caused by rheumatic fever, the system bypasses the crippled valve by establishing a new connection from the left ventricle to the aorta.

Although Sarnoff's laboratory dog—a frisky setter named "Silly"—has been wearing the silicone bypass heart valve for more than eight months, the doctor is unwilling to apply it to humans as yet until the operating procedure is letter-perfect.

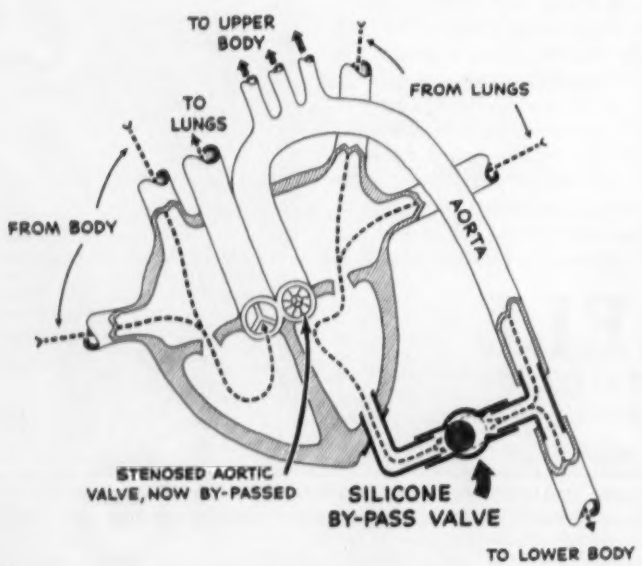
In early attempts Sarnoff attempted to use acrylic plastic for the by-pass valve. It was found, however, that when used in continuity with the heart itself the relatively hard plastic crushed the red cells between the ball and chamber wall, eventually causing anemia. In addition, it made an annoying "tick-tock" sound with each heart beat. The resilience of the elastic silicone valve permits it to take up some of the impact when the valve closes. This has both reduced the red cell destruction to a negligible level and has made the valve quiet.

Dozens of experimental models have already been made in Dow Corning laboratories, molded over glass or mirror-smooth alloy steel mandrels for maximum resistance to clot formation. Flexibility of the entrance tubing allows the ball to be easily forced into place after the case is molded.

This work by Dr. Sarnoff has thus far shown no adverse physiological affects from the implant of Silastic in the body. In fact, the tissue gradually grows in place over the valve.

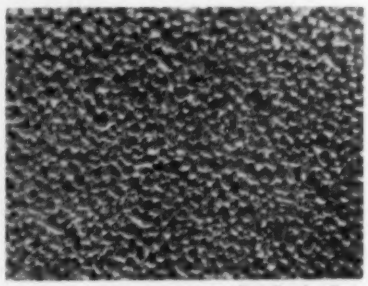
Diagram showing a placement of element to bypass damaged aortic valve.

—National Heart Institute



New Filter

A new line of porous stainless steel filters, Poro-Klean, is now being produced by The Cuno Engineering Corporation. This new filter makes it possible to filter under unusually severe conditions—temperatures up to 1200°F, differential pressures of 2000 PSI, and corrosive liquids or gases. The physical properties of Joro-Klean elements are; tensile strength (ultimate) 9000 to 25,000 PSI, percent of elongation (ductility) 3 to 6%, and percent of porosity 30 to 50%. Particle size retention grades from 3 to 30 microns.



—Dow Corning Corp.

Photomicrograph of porous stainless steel alloy.

Poro-Klean filters elements are produced from spherical powdered stainless steel alloys. The selected powder is sintered in a newly designed furnace which is completely instrumented to insure product uniformity. The sintered materials (note Photo) are inspected and tested for pore distribution, particle size retention, and physical properties. They are then fabricated into filter elements and again inspected for dimensional and functional accuracy. By ulitizing special manufacturing, inspection and evaluation techniques, it is possible for Cuno to furnish a variety of porous metal with a wide range of properties for applications in filteration, transpiration cooling, boundary layer controls and other uses requiring porous metal.

Army's New Unit

Ninety nine thousand gallons of drinkable water were produced and distributed by the Army's new mobile purifier during nine days of emergency operation recently in flood-ravaged Stroudsberg, Penna.

Developed by the Corps of Engineers' Research and Development Laboratories, Fort Belvoir, Va., the

LOOKING BACKWARD . . . 10 YEARS FROM NOW

What will you have to show for yourself?

How much will you have contributed in answer to the pressing demands of an unbelievably exciting period in engineering achievement? How satisfying your progress and your rewards?

The coming decade is, for you, a time of transition. In whatever field you choose to pursue a career, your record of advancement from neophyte to veteran will not depend on ability alone. For . . . without ample opportunities to demonstrate your talents, you cannot prove your potential value in any industry.

Today, at Sikorsky Aircraft, the challenge is a mighty one. Solutions to the intricate problems of advanced rotary wing aircraft will have great bearing on military and commercial progress in the years just ahead. To help provide the right answers, more engineers with foresight and vision are needed.

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truck-mounted unit is capable of purifying 3,000 gallons of water an hour, 24 hours a day. A six-man team of water experts headed by Harry N. Lowe, Jr., Chief of the Laboratories' Sanitary Engineering Branch, worked 13 hours a day to produce quality water in quantities exceeding the demand. This did not require working the unit at full capacity.

Dispatched to Northeastern Pennsylvania at 2 a. m. on the morning of August 20, the group arrived in the Pocono resort town two days later, after assisting in the establishment of an emergency water supply in stricken Scranton.

Although Lowe, Richard J. Gainey, Paul Rodriguez, Joe Kumbar, Joe Mancuso and Broadus E. Shiflett do not claim membership in the Society of American Medicine Men, a Stroudsberg man claims that they would do well in the profession. The lucky customer vows that a special therapeutic value in the purified water cured his lumbago!

The unit, which is nearing standardization by the Army, is a member of a "family" of purifiers which resulted from years of basic and applied research at the Laboratories. Other units include 1500 and 600 gallon-per-hour capacity mobile purifiers, and a semi-permanent one capable of producing 10,000 gallons of drinking water each hour.

Heart of the purifiers is an "erdlator", an all-metal solids contact clarifier which chemically coagulates and removes mud, bacteria and other suspended matter in the water and makes effective disinfection possible.

DEW Line Project

The Distant Early Warning System now being built across the northern rim of the western world, is a joint defense operation of two nations, the United States and Canada, and in concept, construction and execution will be a major engineering achievement. Popularly termed the DEW Line, it is a picket-fence network of radar stations designed to guard against sneak air attacks via the short and direct polar regions. Considering the industrial heart of America as a prime target of any attack, the electronic sentry system will offer several hours of warning—priceless minutes if "Condition Red" is ever sounded.

Feasibility of the DEW Line was first explored by scientists of Bell Telephone Laboratories and Massachussetts Institute of Technology. In 1953 an experimental DEW installation was designed, transported and operated within the Arctic Circle by a Bell Telephone System team with the aid of hundreds of other firms. Special buildings and construction techniques were devised to withstand severe arctic weather. Stations were exhaustively evaluated, designs were modified, equipment was changed to combat polar magnetism, effects of constant wind and cold were measured—both on men and the complex devices they would have to keep operable. Based on observations of the experimental line, American and Canadian authorities agreed that the DEW Line, although a tremendous undertaking, could be built and would work. Early in 1955, the Department of Defense named the Western Electric Company as prime contractor for the development, design, engineering, procurement, construction and installatioinof the full-size Arctic line —the first line of warning, to be integrated into the Continental Defense network headquarters at Colorado Springs, Colorado.

When completed, the DEW Line will stretch across Canada from Alaska to Greenland with station sites located on terrains ranging from desolate flats to rugged altitudes — all virtually inaccessible except by air. So, a network of permanent settlements is being built in a frozen wilderness—a problem of logistics and engineering to the *n*th degree.

While building sites were being selected, vast quantities of construction equipment, materials and supplies had to be procured and delivered to arctic job locations. As engineers and plants across the country were busy designing and manufacturing the equipments to become a part of this DEW Line, the Air Force and Navy were active in getting ready to transport the heavy tonnages to where they would be needed. A major air lift of men and supplies was set in motion. In no time at all military Globemasters were moving heavy ma-

College graduates on the way up...

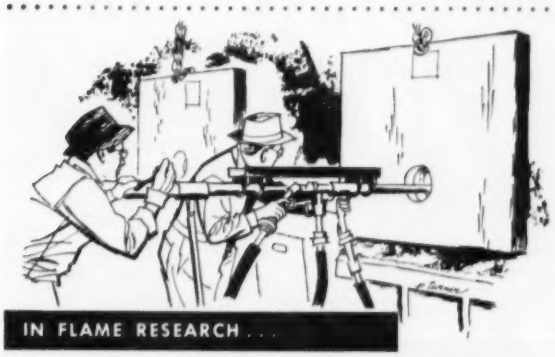
growing with UNION CARBIDE

IN PRECISION METAL CASTING . . .

"I'm a mechanical engineer, Class of '51. Because of my interest in foundry work I joined Haynes Stellite Company, which has a diversified foundry operation. After a familiarization program I was assigned to production work in the investment casting foundry. I'm now in my second year as a foundry foreman, supervising the type of work I like best."

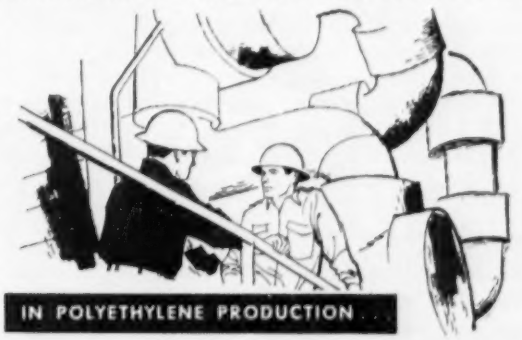
IN PLASTICS DEVELOPMENT . . .

"I'm a mechanical engineer, Class of '52. I wanted to work on the design and development of new production machinery, and Bakelite Company offered me the career I was looking for. I'm working in the fast-growing field of plastics, on a variety of machine design and development problems with the vinyls, phenolics, and polyethylene. To me it's an ideal assignment."



IN FLAME RESEARCH . . .

"I'm a mechanical engineer, Class of '51. I started at the Tonawanda, N. Y., laboratories of Linde Air Products Company, with a small group doing research on fundamentals of combustion and jet-burner design. Recently I became the technical field representative on this project, responsible for field-testing new jet-burners, working with customers under actual steelmill operating conditions."



IN POLYETHYLENE PRODUCTION . . .

"I joined Carbide and Carbon Chemicals Company after receiving my B.S. in Chemistry in 1950. I started in Process Development at the Texas City plant, where I soon found myself in the plastics end of the chemicals business. By 1954 I was production supervisor at a new polyethylene plant at Seadrift, Texas, supervising more than 50 men and working with top plant management.

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Industrial Relations Department, Room 406
30 East 42nd Street, New York 17, N. Y.

chinery, even D-8 tractors weighing over 40,000 lbs., large cranes and motor vehicles. Other aircraft, including Flying Boxcars and small ski-equipped planes flown by skillful bush pilots were hauling tools, food and men to the polar wastes. D-4 tractors were "air dropped" so that they in turn could help construct air fields where large aircraft could later land and discharge heavier cargoes. Many of these air fields were built on ice of the Arctic Sea. Meanwhile, freight was being loaded aboard ships at Canadian and American ports and rushed as far north as possible to waiting planes and snow tractor trains. Much cargo was hauled directly to beaches and sites by LST's and LCU's.

The nature of the arctic poses many new and unusual problems. There is the problem of construction on the Permafrost. Heat leakage from buildings must not be allowed to penetrate the earth's surface and destroy nature's fine balance of temperature which might cause the earth to settle badly. Seemingly little things become important. Finding a way to extract heat from the diesel-jacket water and the diesel exhausts to provide normal building heating requirements was a major accomplishment. This reduces diesel oil requirements by about 1/3 in a land where fuel consumption is always a factor. In the areas where the DEW Line is being constructed winds sometime exceed the velocity of 100 mph and temperatures 50°F below freezing are not an exception. Equipment design and all construction must reorganize such conditions.

The DEW Line must also conserve manpower wherever possible. This is being accomplished by the automatic equipment wherever practicable. Here is engineering where equipment must be designed to operate faithfully around the clock with an absolute minimum of maintenance.

The DEW Line project is a noteworthy example of cooperation—between governments, armed services, and civilian enterprises. They are building tomorrow's communications system today. Some techniques developed for this work were unknown even three years ago. Now shrouded for security reasons, these advances will be serving the public in everyday use in the foreseeable future.

Rocket Research

After nearly ten years of extensive research and development of rocket engines, North American Aviation today established the Rocketdyne Division as a separate group to carry on continued research, development and manufacture of high powered rocket engines and related items.

The Rocketdyne Division is the outgrowth of the company's Propulsion Center which in recent years has gained a reputation as one of the country's outstanding groups in the design, development and manufacture of large liquid propellant rocket engines.

"Creation of the Rocketdyne Division," J. H. Kindelberger, Chairman of the Board said, "marks continued progress of our work in this field. We now are manufacturing engines for a number of missile programs and recently signed a license agreement with Rolls-Royce, Ltd., for manufacture of North American-designed rocket engines in Great Britain in support of the Wilson-Sandys Collaboration Agreement on guided missiles between the United Kingdom and the United States."

Besides its work in large rocket engines, the division also is engaged in the development of armament rockets for aircraft and basic research on propellants, combustion and in other related fields. North American entered this field in 1947 as part of its program of guided missile development.

S. K. Hoffman, who has headed the Propulsion Center, has been named general manager of the Rocketdyne Division reporting to L. L. Waite, vice president in charge of North American's Missile & Control Equipment operations.

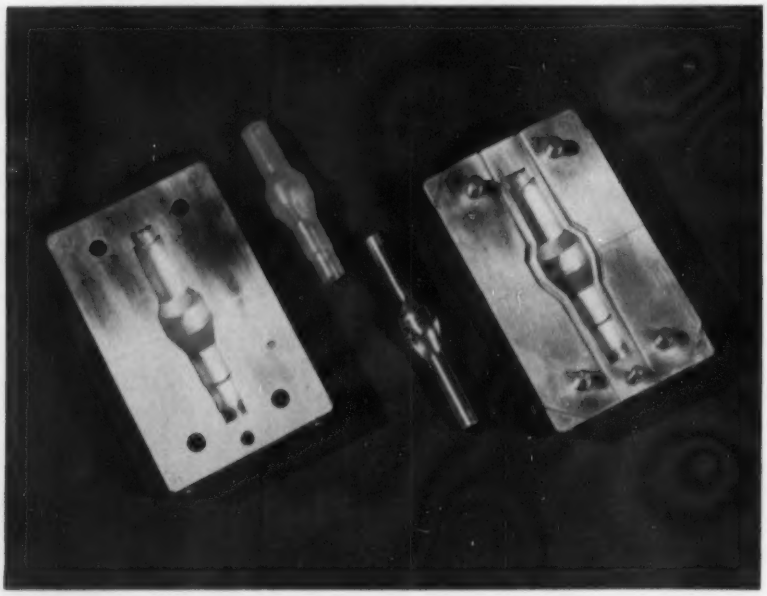
The Rocketdyne Division has started occupying a $3,475,000 building nearing completion in the Canoga Park section of West San Fernando Valley, where engineering and manufacturing operations will be located.

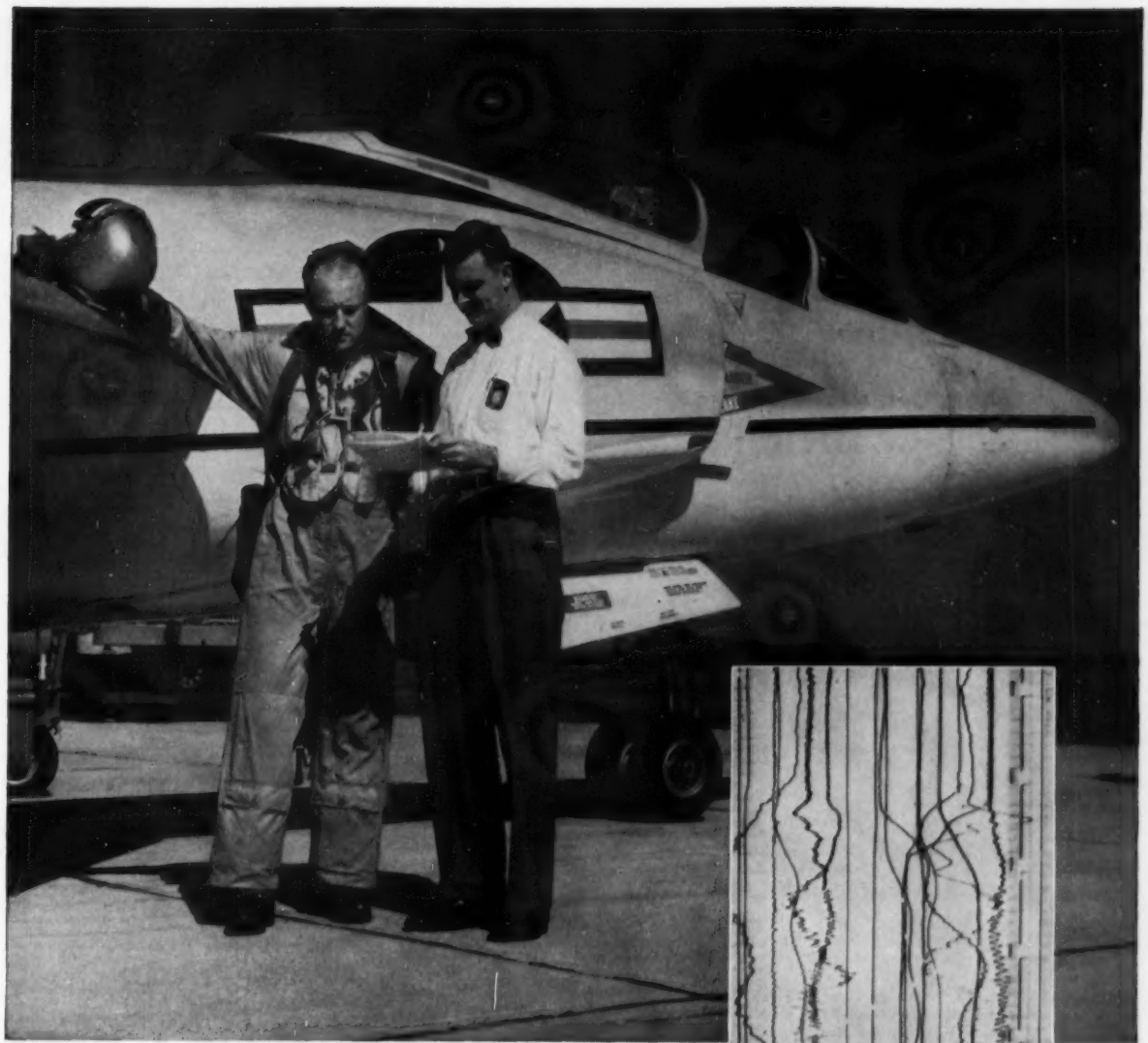
The new headquarters will be near the division's Field Laboratory in the Santa Susana Mountains. Activated in 1948, the Field Laboratory is one of the country's largest and most complete facilities for testing high powered, lightweigh rocket engines, fuels and armament rockets. These facilities now are being enlarged under an expansion program to be completed by mid 1956.

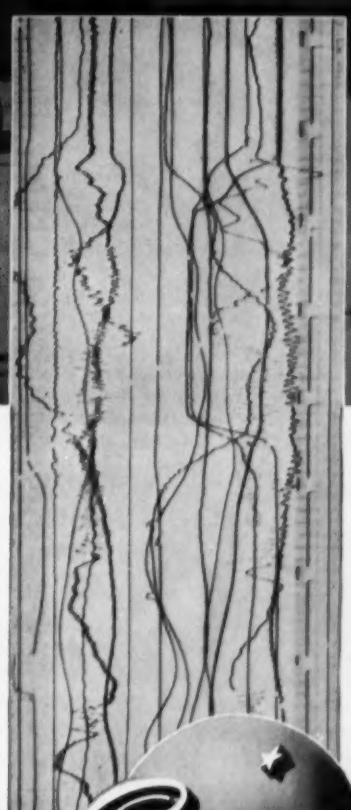
The Rocketdyne Division presently employs approximately 4,000 people.

Plain steel compression mold halves are clamped together over 14 grams of Silastic and a glass or highly-polished steel mandrel to form a single heart valve. A press cure of 10 minutes at 250°F. is followed by an oven cure of one hour at 480°F. Note "flash channels" parallel to the main cavity.

—National Heart Institute







GRUMMAN ENGINEERS TEST FLY JET FIGHTERS

While only one test pilot-engineer flies a new supersonic jet fighter, dozens of Grumman engineers go along via pre-flight planning, in-flight telemeter recording, and post-flight analysis of oscillograph records. By telemetering, the engineers on the ground receive data on control forces, structural loads, temperatures, vibrations and accelerations imposed on the airplane by predetermined maneuvers. Later, the oscillograph records are read by electronic machines which reduce the data for detailed analysis.

To learn more about the interesting role of engineers at Grumman, write for the booklet *Engineering for Production.*

★

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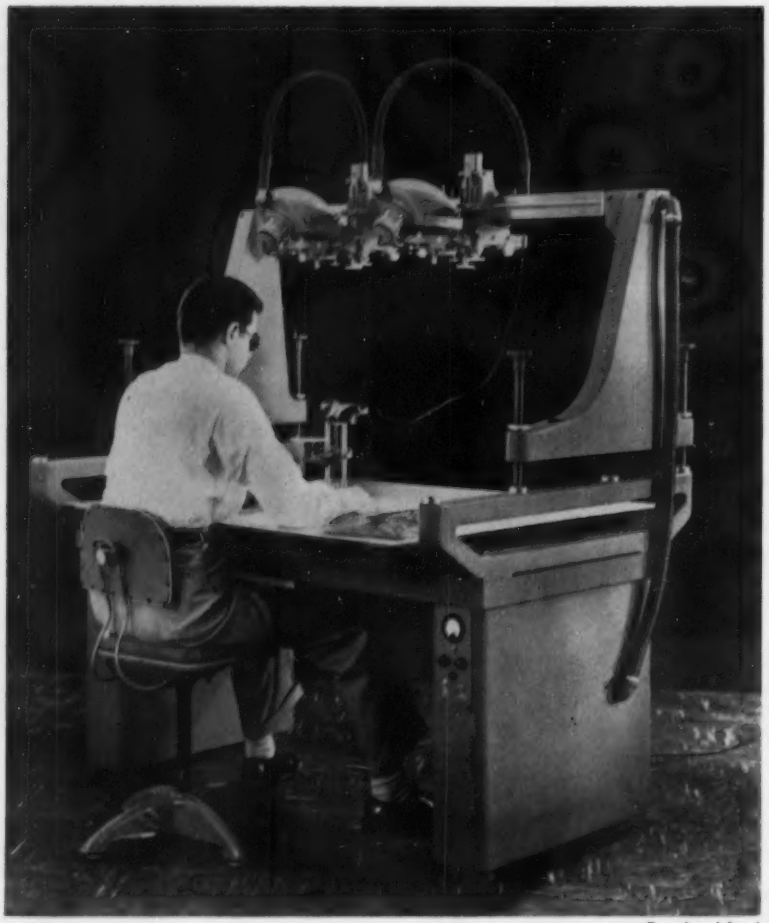


—*Bausch and Lomb*

Shown above is a new plotting instrument introduced by Bausch & Lomb Optical Co. Aerial photographs are mounted in the two projector heads over the table. The images, when observed through stereo glasses, produce a view of the ground such as might be seen with eyes several hundred feet apart. The operator traces this ground image, producing one contour line at a time. The instrument rapidly produces maps with 2-foot contour intervals, and sells for $4,250.

Dr. Theodore von Karman, senior scientific adviser on aeronautics to NATO and the United States Air Force, has been named a director of Gruen Precision Laboratories, Inc., newly formed subsidiary of the Gruen Watch Company of Cincinnati.

Known as the man who exercised the greatest influence in the development of high speed aircraft in the United States, Dr. von Karman holds two key positions in the western world's air defense system. He is chairman of the aeronautical research and development group of NATO and chairman of the United States Air Force's scientific advisory board. In 1954, he was awarded the Wright Brothers Memorial Trophy for his contributions to the science of aeronautics.

As director of the Guggenheim Aeronautical Laboratories at the California Institute of Technology, Dr. von Karman built one of the world's outstanding aeronautical research centers.

In 1938, at the request of General Arnold, wartime chief of the Air Force, he undertook leadership of the Army Air Force's first jet propulsion and rocket motor program. His concepts led to starting research on the Bell X-1, first plane to break the sound barrier.

Prior to World War II, Dr. von Karman proposed to the Ordance Department of the Army that supersonic wind tunnels be utilized in ballistics research. His work from 1940 to 1942, in developing a model supersonic wind tunnel at California Institute of Technology, led to the design and operation of the ballistics wind tunnel at Aberdeen Proving Grounds. He has been a member of the scientific advisory committee of the Ballistics Research Laboratory at Aberdeen since 1940.

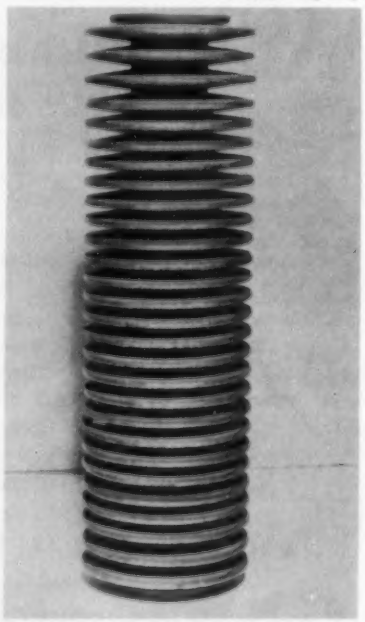
In 1944, the Air Forces named Dr. von Karman director of its scientific advisory group and special consultant to General Arnold.

As a delegate from the United States, Dr. von Karman attended the Fifth Volta Congress in Italy in 1935 and there presented the first theory of air resistance of bodies moving at supersonic speed. This theory is now known as the Karman Vortex Trail.

Dr. von Karman has held the post of lecturer at leading universities in the United States, Europe and Asia. He is currently a member of most of the world's leading academies of science. Writer and editor of many books and articles, his most recent example is "Aerodynamics", published by Cornell University in 1954. His reports as head of the USAF Scientific Advisory Group include, "Where We Stand", which in 1945 assessed the American position in critical research areas. The Group likewise published the thirty volume series, "Toward New Horizons." The summary volume, "Science: Key to Air Supremacy," formed a blueprint for the Air Force scientific development.

Filter apparatus consisting of cell type elements of sintered alloy.

—*Dow Corning Corp.*



1956-1957

The Ramo-Wooldridge Fellowships in

SYSTEMS ENGINEERING

FOR

Graduate Study at the

California Institute of Technology

or the

Massachusetts Institute of Technology

The Ramo-Wooldridge Fellowships in Systems Engineering have been established in recognition of the great scarcity of scientists and engineers who have the very special qualifications required for work in Systems Engineering, and of the rapidly increasing national need for such individuals. Recipients of these Fellowships will have an opportunity to pursue a broad course of graduate study in the fundamental mathematics, physics, and engineering required for Systems Engineering work, and will also have an opportunity to associate and work with successful engineers and physicists in this field.

Systems Engineering encompasses difficult advanced design problems of the type which involve interactions, compromises, and a high degree of optimization between portions of complex complete systems, as for example, between the electrical, mechanical, aeronautical, and chemical portions of a system. As an added complication the design of such systems is frequently very closely related to the characteristics of the human beings who will maintain and operate the systems. For the purpose of the Fellowship program, the words "Systems Engineering" are considered to include the techniques and practice of "Operations Research."

The program for each Fellow covers approximately a twelve-month period, part of which is spent at The Ramo-Wooldridge Corporation, and the remainder at the California Institute of Technology or the Massachusetts Institute of Technology working toward the Doctor's degree, or in post-doctoral study. Fellows in good standing may apply for renewal of the Fellowship for a second year.

ELIGIBILITY—The general requirements for eligibility are that the candidate be an American citizen who has completed one or more years of graduate study in mathematics, engineering or science before July 1956. The Fellowships will also be open to persons who have already received a Doctor's degree and who wish to undertake an additional year of study focused specifically on Systems Engineering.

AWARDS—The awards for each Fellowship granted will consist of three portions. The first will be an educational grant disbursed through the Institute attended of not less than $2,000, with possible upward adjustment for candidates with family responsibilities. The second portion will be the salary paid to the Fellow for summer and part-time work at The Ramo-Wooldridge Corporation. The salary will depend upon his age and experience and amount of time worked, but will normally be approximately $2,000. The third portion will be a grant of $2,100 to the school to cover tuition and research expenses.

APPLICATION PROCEDURE

For a descriptive booklet and application forms, write to The Ramo-Wooldridge Fellowship Committee, The Ramo-Wooldridge Corporation, 8820 Bellanca Avenue, Los Angeles 45. Completed applications together with reference forms and a transcript of undergraduate and graduate courses and grades must be transmitted to the Committee not later than January 20, 1956.

The Ramo-Wooldridge Corporation

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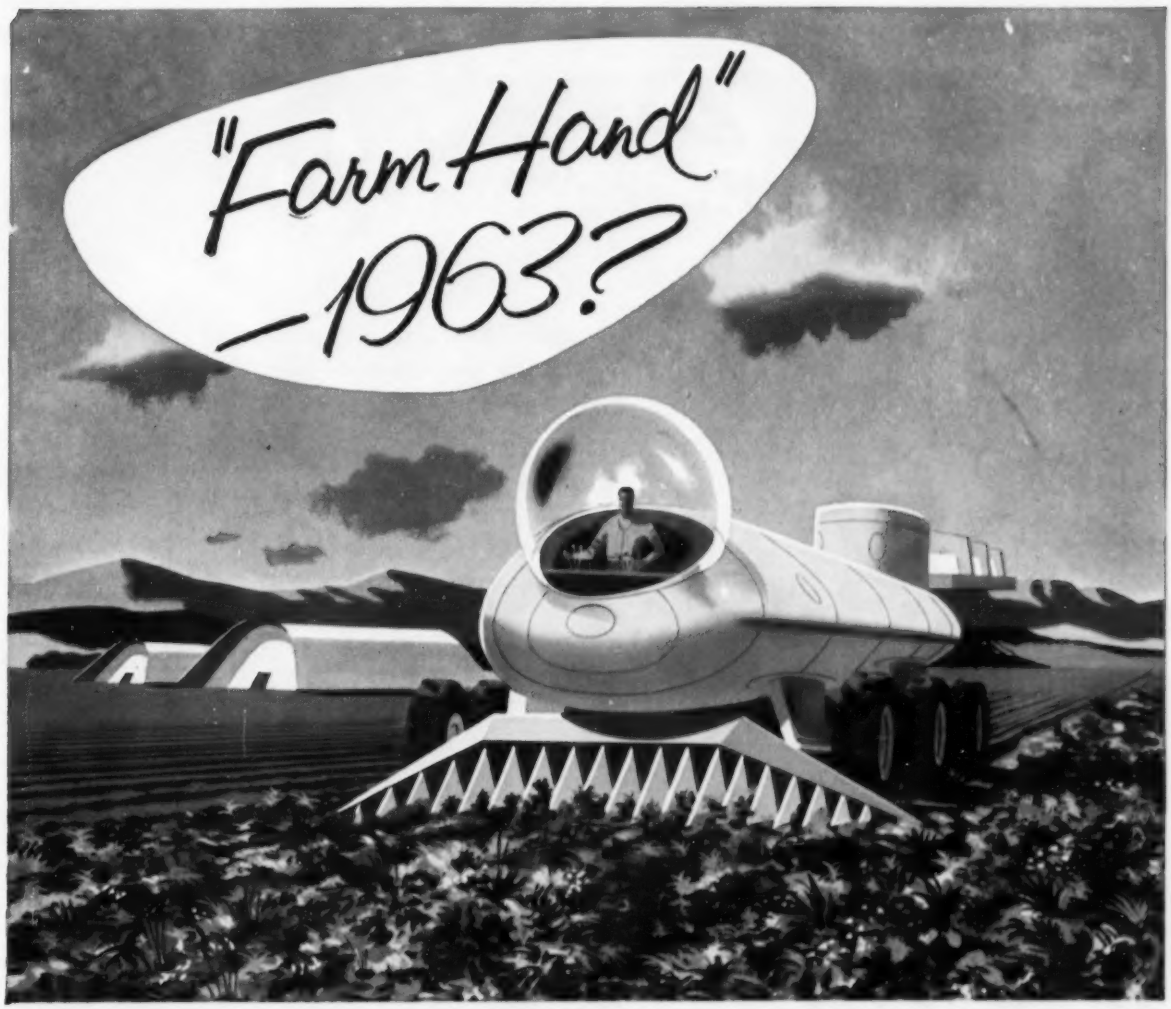
NEW DEPARTURES OF TOMORROW



Today, New Departures are used by almost every manufacturer of farm equipment. That's because New Departure ball bearings have proved their ability to carry all loads, preserve accurate alignment of moving parts, cut friction and upkeep.

How you gonna keep 'em away from the farm after they've seen this machine? . . . Chances are, the people who develop this soil-conditioner, fertilizer-planter unit, with its air-conditioned control cab, will call on New Departure for ball bearings. Maybe they'll just need New Departures that are already in world-wide use—like the Sealed-for-Life or the double-row angular-contact ball bearings. Or they might want an entirely new type—a "new departure" in ball bearing design. Either way, New Departure is the answer. Manufacturers everywhere know that New Departure always lives up to its name—being *first* with the finest in ball bearings.

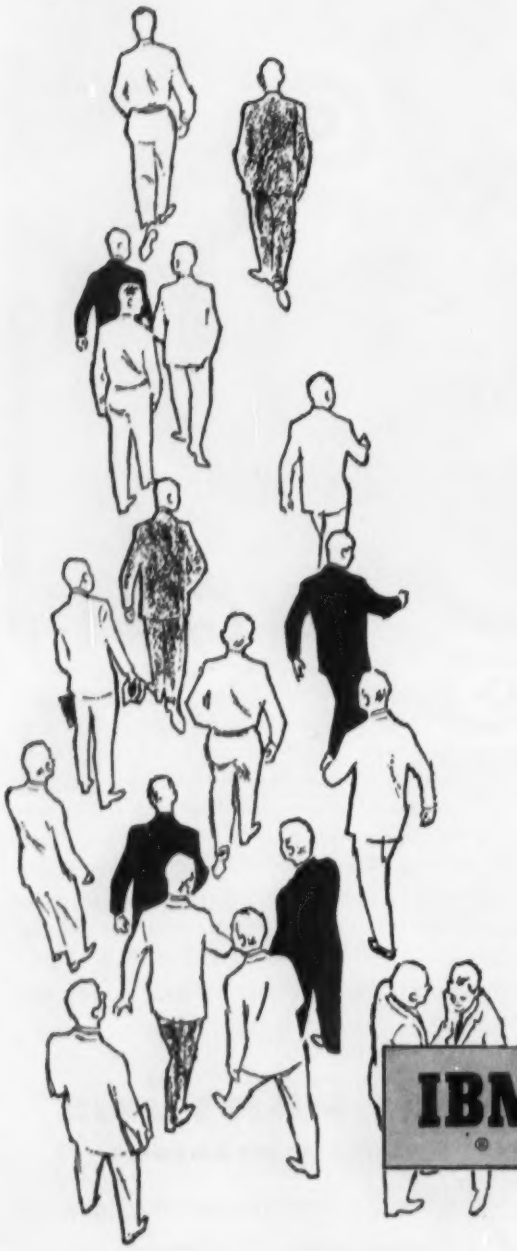
NEW DEPARTURE • DIVISION OF GENERAL MOTORS • BRISTOL, CONNECTICUT

NEW DEPARTURE
BALL BEARINGS

NOTHING ROLLS LIKE A BALL

(A message from **IBM**—*where progress is engineered)*

Pioneer or "Routineer"?



In simplest possible terms, there are two basic courses open to you when you apply your engineering degree in the business world . . . you can "routineer" or pioneer. As a routineer you will fill in the details of other men's concepts. As a pioneer you will operate on the frontiers of your chosen field—helping *originate new concepts.*

Which course *you* follow depends largely on the field you select and the company you join.

There is underway today, in business, science, and government, a quiet but far-reaching revolution in the automation of office equipment and procedures. The use of electronic data processing machines—for performing complex scientific computations . . . for handling huge volumes of business data—is still in its infancy. For engineers in data processing, new horizons unfold in endless succession.

IBM's leadership in the field of data processing is due largely to our reliance on pioneer engineering. Many years ago IBM deliberately set out to build the kind of engineering climate . . . the facilities, the freedom, the associations . . . that would attract and stimulate the pioneer.

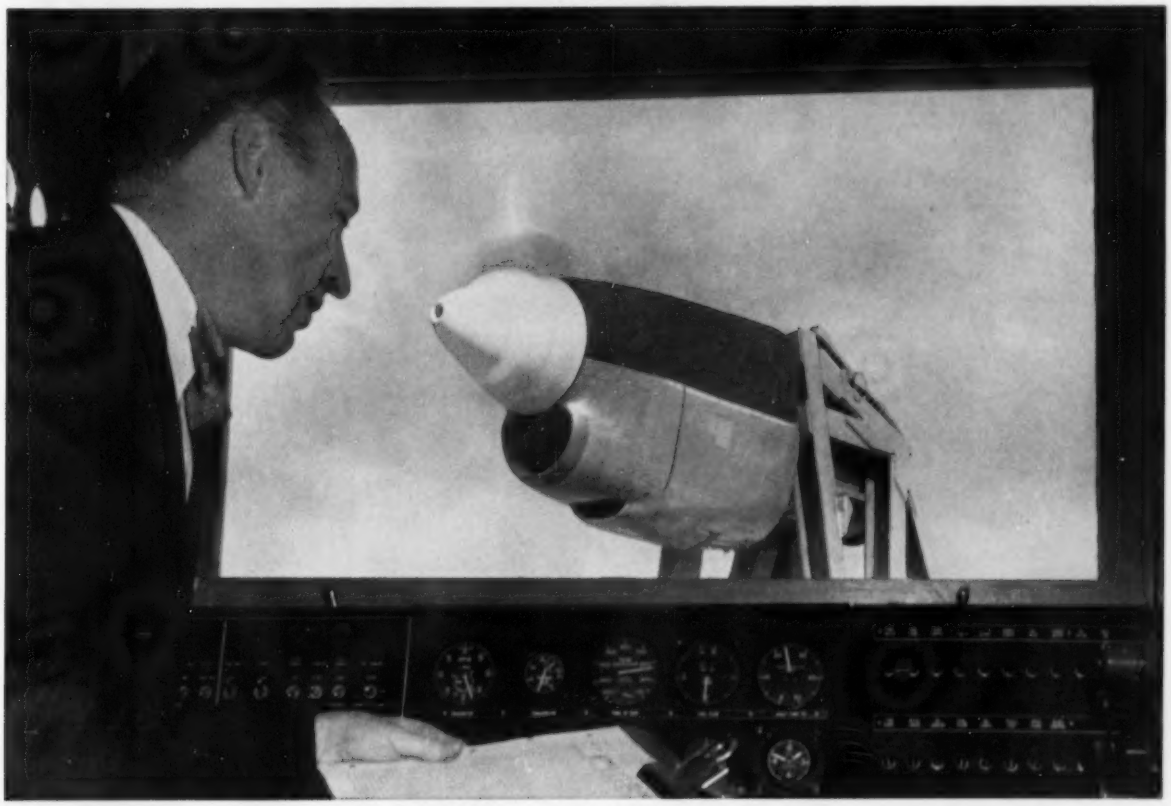
If *you* want to pioneer in a dynamic new field, IBM offers an unusual opportunity to make important and rewarding contributions.

FOR FURTHER INFORMATION about IBM, talk with your college placement director or write to W. M. Hoyt, IBM, 590 Madison Ave., New York 22, N. Y.

IBM

World's largest producer of electronic data processing machines, electric typewriters, and electronic time equipment.

16 TIMES "AROUND THE WORLD" AND NEVER OFF THE GROUND!



WHAT KIND of double talk is that—"16 Times Around the World, and Never Off the Ground?"

It's like this. With Allison's entry into the commercial airline field, there is a need for flight data on turbo-prop engines before they are put into regularly scheduled commercial service. In the absence of actual data, Allison is running a 1000-hour test schedule with a Model 501 turbo-prop engine mounted on an outdoor test rig.

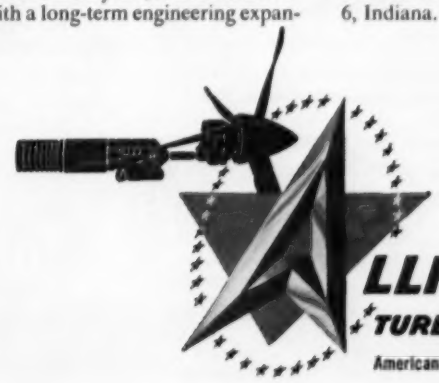
In reality, 1000 hours of flying time represents about 16 times around the earth, is the equivalent of about 4 months of normal, commercial airline usage.

For this test, actual airline operating schedules are used. This means that the engine is run through complete cycles of starting, ground idle, take-off, climb, cruise and descent for landing, and the cycle is repeated continuously 'round the clock as the schedule simulates trips of from 250 to 2500 mile blocks.

One of the young engineers who has been working on the project from the start is Donal J. Nolan, shown above at the test instrument control panel. Don is assistant chief, installation engineering at Allison. After his graduation in '42 from Case Institute of Technology, he came to General Motors in 1943 with a degree in ME.

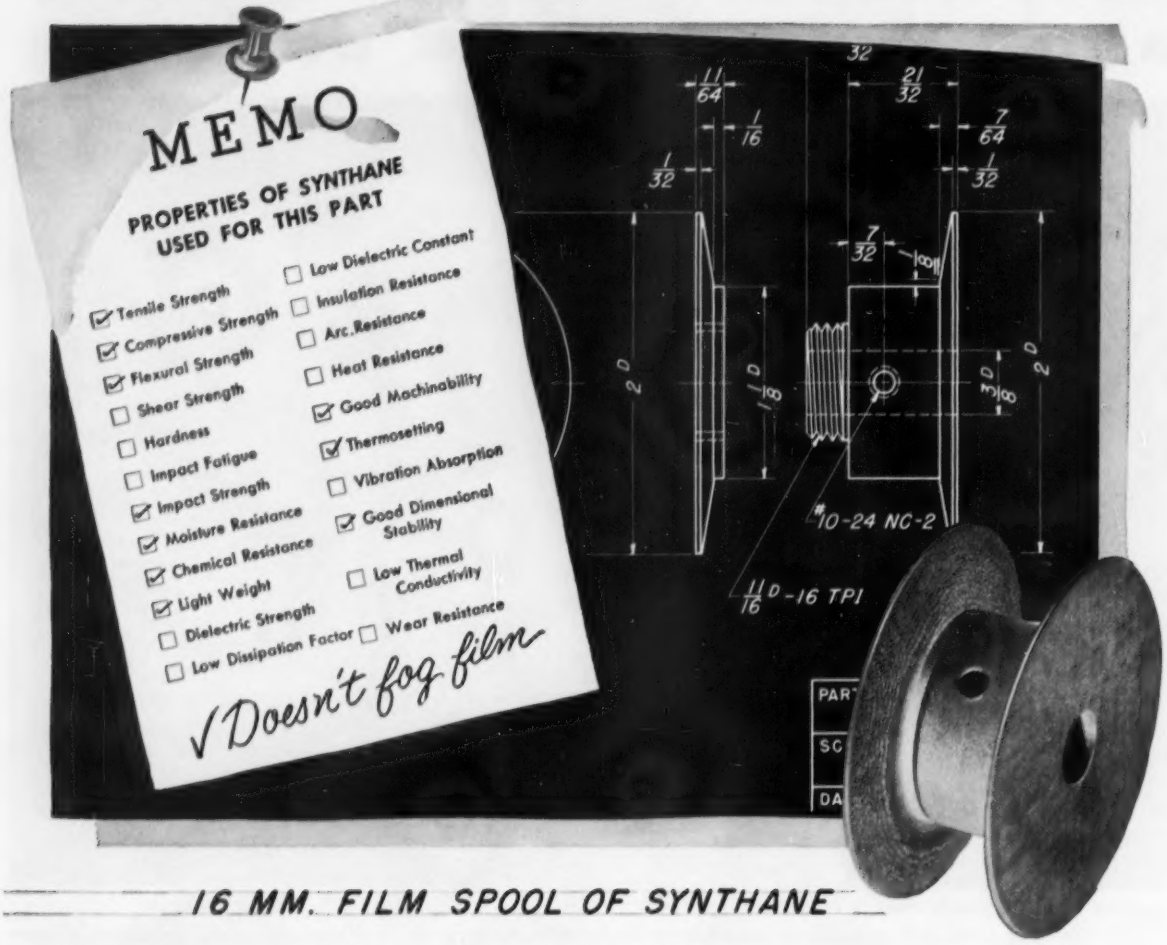
Commercial acceptance of the Allison turbo-prop engine started with the purchase of a quantity of Allison-powered Lockheed Electras by American Airlines. This initial purchase, plus plans of other leading airlines to adopt the Electra, opens a new chapter in the growth and development of Allison Division of General Motors Corporation. Already a leader in the design, development and production of turbo-jet and turbo-prop engines for military use, Allison is underway with a long-term engineering expansion program covering advanced military and commercial engine installations. This $75,000,000 program, providing for newest engineering and research facilities, intensifies the *immediate* need for engineers.

Opportunity for young graduate engineers is unlimited at Allison. Arrange now for an early interview with our representatives on your campus, or write now for information about the possibilities of YOUR engineering career at Allison: R. G. GREENWOOD, Engineering College Contact, Allison Division, General Motors Corporation, Indianapolis 6, Indiana.



ALLISON
TURBO-PROP ENGINES
American built for the new era in air travel

YOU FURNISH THE PRINT, WE'LL FURNISH THE PART



16 MM. FILM SPOOL OF SYNTHANE LAMINATED PLASTIC RESISTS PHOTOGRAPHIC CHEMICALS, HOLDS SHAPE, DOESN'T FOG FILM.

The film spool we're talking about is one used in the processing of movie film. The material for this spool has to be light in weight, strong and easily machined. Since it is always in contact with film and photo solutions, it must also be chemically-resistant and—most important—not fog the film by chemical contamination.

This isn't an easy assignment for any material, but *Synthane* fills the bill.

Whenever you want parts requiring many properties, consider how *Synthane's* combined benefits may help you improve your product.

Synthane produces finished parts from many different grades of *Synthane* laminated sheets, rods, tubes and molded-laminated and molded-macerated parts. Service and quality characterize *Synthane* fabrication.

We can handle the whole iob for you from your print to the finished part—eliminating your tooling-up, reject and machining problems—and producing parts of excellent quality at a saving of your time and money.

For more information about *Synthane* grades, properties and fabrication facilities, send in the coupon.

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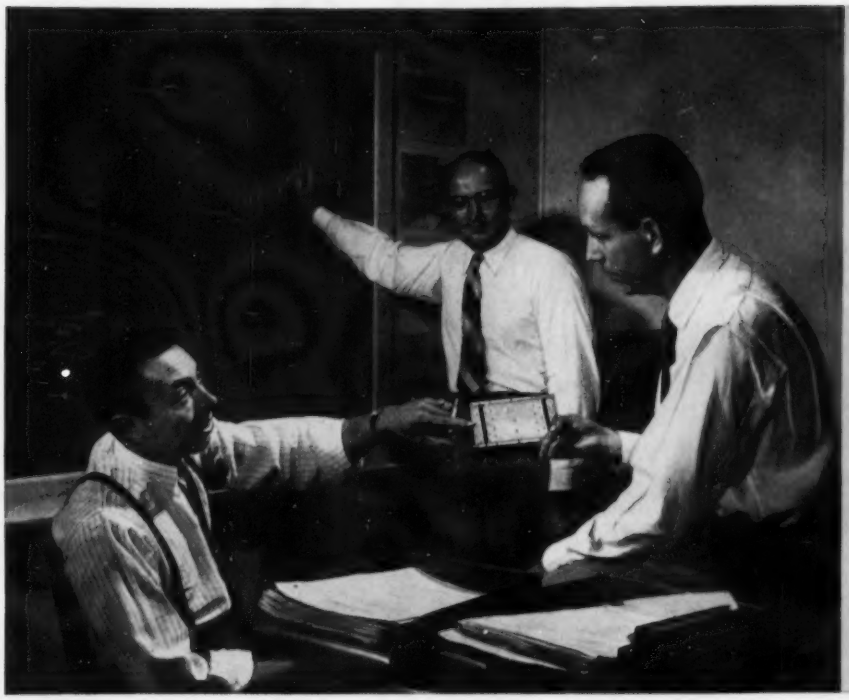


Research Specialist Edward Lovick (right) discusses application of experimental slot antenna in the vertical stabilizer of a high-speed aircraft with Electronics Research Engineer Irving Alne and Electronics Research Engineer Fred R. Zboril.

Lockheed antenna program offers wide range of assignments

Airborne Antenna Design is one of the fastest-growing areas of endeavor at Lockheed. Advanced development projects include work on stub, slot, reflector-type, horn and various dipole antennas.

These diverse antenna activities reflect the full scope of Lockheed's expanding development and production program. For with 13 models of aircraft already in production and the largest development program in the company's history underway, the work of Lockheed Antenna Designers covers virtually the entire spectrum of aircraft, commercial and military.

You are invited to contact your Placement Officer for a brochure describing life and work at Lockheed in the San Fernando Valley.

Lockheed AIRCRAFT CORPORATION • *California Division*

BURBANK • **California**

Factory testing of "U.S." electrical wires and

In Cable Testing, Part I (No. 9 in the series) this subject was outlined in a general way and Factory Tests on Entire Lengths were discussed in somewhat greater detail. Part II concludes this subject and discusses (in some detail) sample and miscellaneous tests made at the factory and tests after installation.

SAMPLE TESTS

These tests, as the name indicates, are made on short samples selected at any stage during manufacture or from the completed cable.

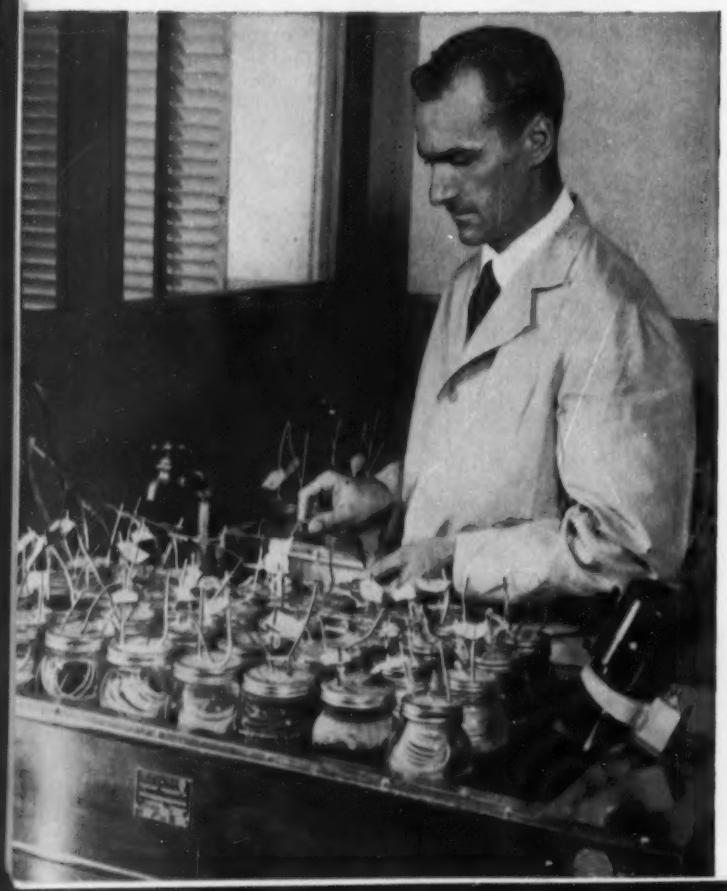
CONDUCTOR TESTS. Dimensional tests, tensile strength, elongation and quality of coating tests are made on the conductor to insure that the processing operations have been performed properly and that the conductor will meet the specification requirements.

INSULATION AND JACKET THICKNESS. The minimum and average thickness of insulations and jackets are determined by suitable micrometers or micrometer microscopes to determine compliance with the thickness requirements.

PHYSICAL TESTS. These tests determine the tensile strength, elongation, tensile stress and set of rubber and rubber-like or thermoplastic insulation and jacket compounds. Tensile strength and elongation are measured at the breaking point. Tensile strength in pounds per square inch is calculated from the cross-sectional area of the original test specimen. Elongation is expressed in per cent of the unstretched length. Tensile stress is the tension in pounds per square inch required to elongate a sample a given amount, usually 200 per cent. Set is a measure of the recovery after a specified elongation.

AGING TESTS. These are accelerated tests in which the effect of heat and/or increased oxygen concentration on the tensile strength and elongation of insulations and jackets is determined. The results of such tests indicate the temperature (conductor temperature) at which such insulations or jackets will operate continuously and their life-expectancy at higher temperatures. For example, an insulation that shows not more than 25 per cent depreciation in tensile strength and elongation after 96 hours in the oxygen bomb at 70° C is suitable for continuous operation at 60° C while an insulation that shows not more than 25 per cent depreciation in these characteristics after 168 hours in the oxygen bomb at 80° C is suitable for operation at 75° C.

Electrical tests, such as voltage breakdown, insulation resistance, power factor, etc., are frequently made during the development of insulating compounds to determine the effect of such aging on these properties. Such tests, however, are generally not covered by industry specifications.

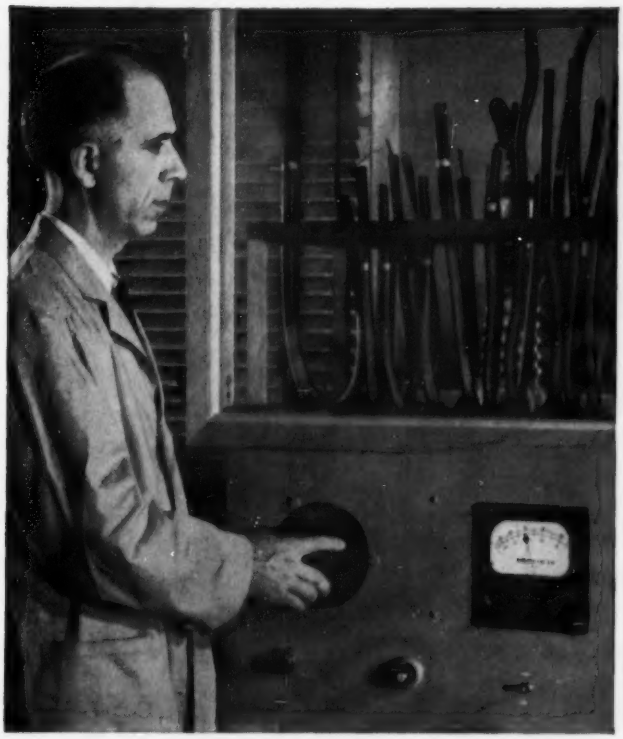


MOISTURE ABSORPTION. The effect of moisture on the properties of insulations is important, particularly where they are exposed directly to water in service. Moisture absorption is determined by the gravimetric method and by the electrical method. In the gravimetric method a suitable sample is weighed, immersed in distilled water for 7 days at 70° C and reweighed. The gain in weight is expressed in milligrams per square inch of exposed surface. In the electrical method, the sample is immersed in water at 50° C and its capacitance is determined after one, seven, and fourteen days. The increases in capacitance from the first to the fourteenth and the seventh to the fourteenth days are a measure of moisture absorbed.

US RUBBER

No. 10 in a series

cables–Part 2 *(plus tests after installation)*



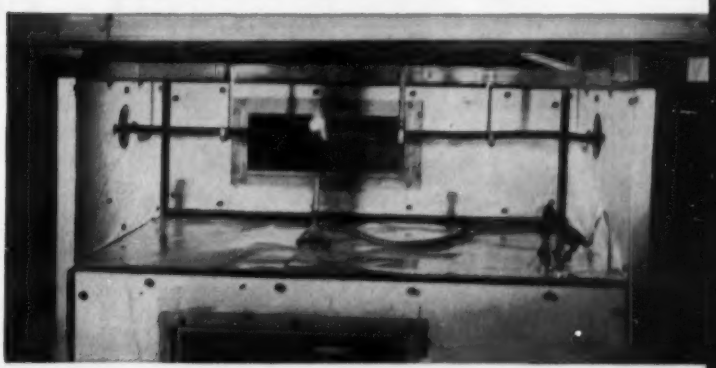
OZONE RESISTANCE. To determine the effect of ozone on insulations or jackets, a sample is bent around a mandrel of such diameter that the material under test is stretched about 15 per cent and then exposed to an atmosphere containing ozone at room temperature. One of two concentrations of ozone, namely 0.013 or .027 per cent is used, depending on the type of insulation. Acceptable insulations must withstand such exposure for a specified time without cracking. Ozone resistance is generally required only on those compounds designed for operation at above 5001 volts.

CAPACITY AND POWER FACTOR. The dielectric constant and power factor are important characteristics of insulations designed for use on high-voltage power circuits or on most communication circuits since they are a measure of the energy absorbed by such insulations. The dielectric constant is calculated from capacity measurements on a sample of known dimensions. For high-voltage cables, these measurements are made at the operating voltage of the cable at a frequency of 60 cycles after immersion in water for 24 hours. For communication cables, the measurements are generally made at 1000 cycles with about 20 volts applied to the insulation.

DIELECTRIC STRENGTH TEST. Samples of insulated cables designed for operation at voltages above 5001 volts are required to withstand for five minutes the application of a voltage twice the factory test voltage after immersion in water for at least one hour. Following this test, the voltage on the sample is increased 20 per cent and held for five minutes. This cycle is repeated until breakdown occurs and the breakdown voltage recorded for information only.

COLD BENDING AND LONG-TIME DIELECTRIC STRENGTH. Samples of cables designed for operation at voltages above 5001 are required to withstand bending at −10° C around a mandrel approximately ten times the cable diameter followed by the application of the factory test voltage for two hours. This test insures that the insulation and jacket have the required flexibility to withstand bending during installation.

MISCELLANEOUS TESTS. Numerous additional tests are required by specifications for wires and cables to determine their suitability for their particular applications. The more important of these include, abrasion, compression, cutting, low-temperature, tear and weathering tests on insulation and jacket compounds, and abrasion, bending, compression, flame and twist tests on completed cables. The results of such tests are of great value in the design of new types of wires and cables.



TESTS AFTER INSTALLATION

Wire and cable industry practice permits the application of an a-c voltage equal to 80 per cent of the factory test voltage for five minutes to metallic-armored, lead-sheathed or shielded cables immediately after installation. For proof-testing 75 per cent of the factory test voltage may be used. When a d-c test is used, its value for ozone-resistance insulation is three times the a-c value.

To obtain reprints of this advertisement, write Electrical Wire & Cable Department, Rockefeller Center, New York 20, N. Y.

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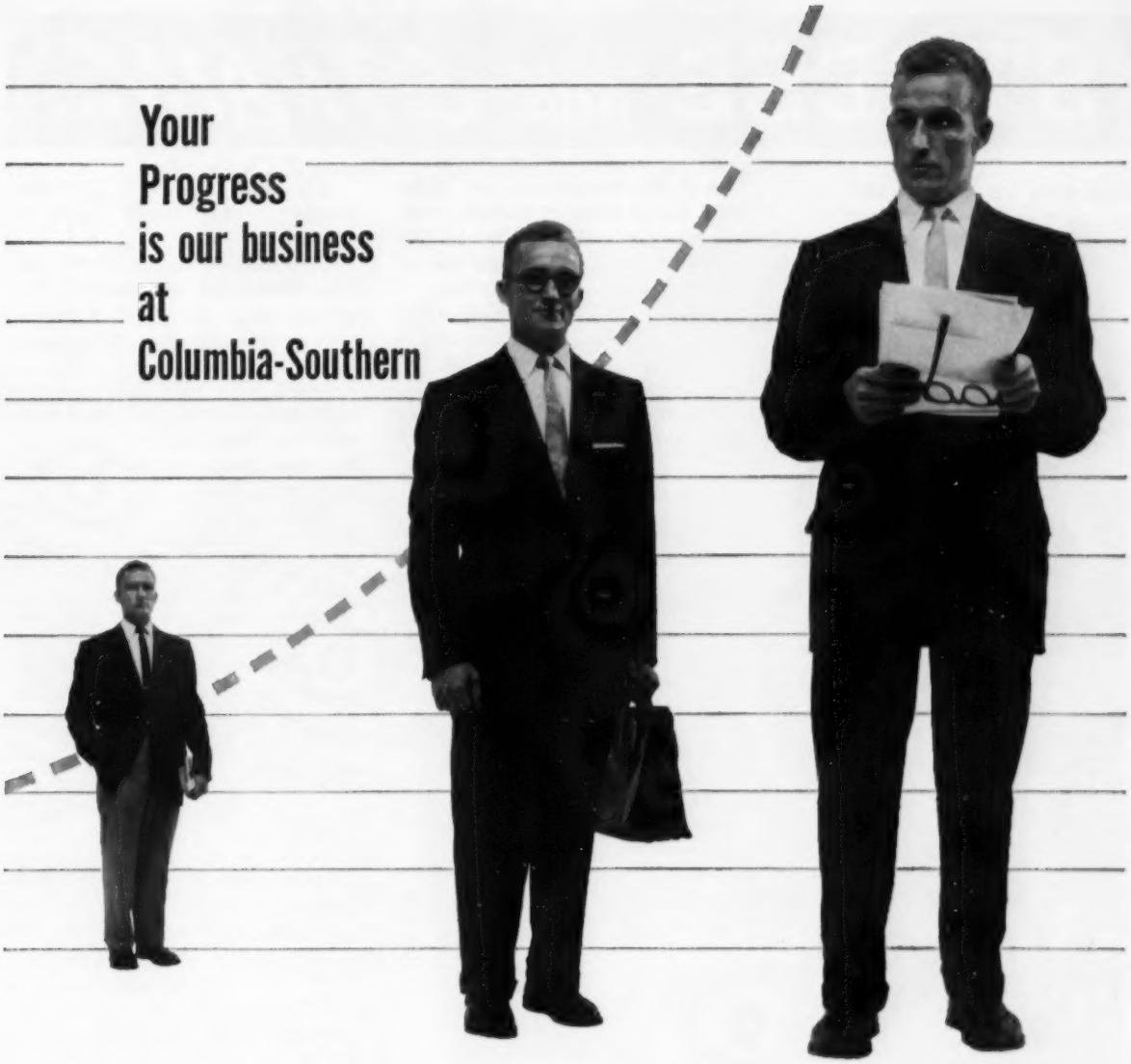
United States Rubber

Your Progress is our business at Columbia-Southern



Naturally, the reason for hiring any man at Columbia-Southern is that we believe he is qualified to fill one of the initial assignments available.

But what we want most are men for whom the first job is merely a starting point. We expect Columbia-Southern to keep up its impressive growth record and we want men who can not only grow with the company, but who can help make that growth possible.

Ultimate advancement at Columbia-Southern does not depend on any particular type of specialized training. Because the company's operations are centered chiefly around chemical production and research, more chemists and chemical engineers seek employment than people with other kinds of training, and more are hired for initial assignments. But numerous other abilities in a wide variety of fields are needed —and in consideration for advancement, the important thing is not what kind of degree a man has but how much responsibility he can handle.

It is not unusual for a college man to be uncertain as to just what type of work he will find most interesting. That's why our new employees are given "on the job" training. It affords new employees the opportunity to perform various assignments so that the employee, as well as the company, will discover the job in which he will be happiest and for which he is best suited.

Columbia-Southern offers qualified graduates a liberal starting salary. More important, each employee's progress is reviewed periodically to insure that salary level keeps pace with demonstrated professional growth and responsibilities.

Columbia-Southern has a need for promising young graduates *now*. If you would like more information, write today to Personnel Manager at our Pittsburgh address or any of the plants.

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STRESS and STRAIN...

Answers To This Month's Brain Teasers

1. One third of the way back from the head of the column's original position.
2. The shortest line that will do this is $\sqrt{42}$ inches.

A streetcar passenger was puffing away on a cigar and the conductor pointed sarcastically to the "No Smoking" sign. "Oh I saw it," said the passenger, "but I can't follow all the rules. For example, the card beside it says, 'Wear Excelsior Corsets'."

* * *

And this one is supposed to be true: An engineer at DuPont wanted to talk with a man by the name of Secsour in the power plant at Kodak.

When he was connected to the power plant, he asked the engineer who answered the phone, "Do you have a Secsour there?"

"Hell no," was the reply. "We only get ten minutes for coffee."

* * *

Just as Rastus was finishing a pail of drinking water out of the creek, an alligator reared its ugly head and Rastus made a dash for higher land. He reported the circumstances to his boss, who promptly sent him back down with another bucket.

"Rastus," he told the darky, "that alligator was just as scared as you were."

"Boss," replied Rastus, "if dat 'gator was scared as me, dat water jus' ain't fit to drink."

* * *

Little boy watching milkman's horse: "Mister, I bet you don't get home with your wagon."

Milkman: "Why?"

Little boy: "Cause your horse just lost all his gasoline."

* * *

Trying to rest after an exceedingly hard day at the office, poor father was being bedeviled by a stream of unanswerable questions from little Willie.

"What do you do down at the office?" Willie finally asked.

"Nothing," shouted the annoyed father.

After a thoughtful pause, Willie inquired: "Pop, how do you know when you're through?"

She's the kind of a girl who whispers sweet nothin' doin's in your ear.

The motorist stopped at the crossroads, and said to the yokel at the side of the road, "Can you tell me how to get to Clappison's Corners?"

"Wall, no," said the yokel, "I ain't sure. I know you don't take that there road and you don't take this here one. I guess as how I don't really know.

The motorist drove on, but looking in the windshield mirror after getting down the road about 200 yards, he saw the yokel running down the road shouting and yelling, and another chap with him. Stopping the car he waited for them. The yokel pulled up triumphantly alongside the car and said, "This here's my friend. He don't know either."

* * *

"Hey! Did you see that young lady smile at me?"

"That's nothing. The first time I saw you I laughed right out loud."

* * *

A Countess sued a man for defamation of character because he had called her a pig. The man was fined, and afterwards, he asked the judge, "You mean I can never call the Countess a pig again?"

"That's right," was the reply.

"Well," said the defendant, "is it all right if I call a pig countess."

"That you can do," replied the judge.

The defendant then turned toward the witness box, looked her right in the eye, and said, "Good afternoon, Countess."

* * *

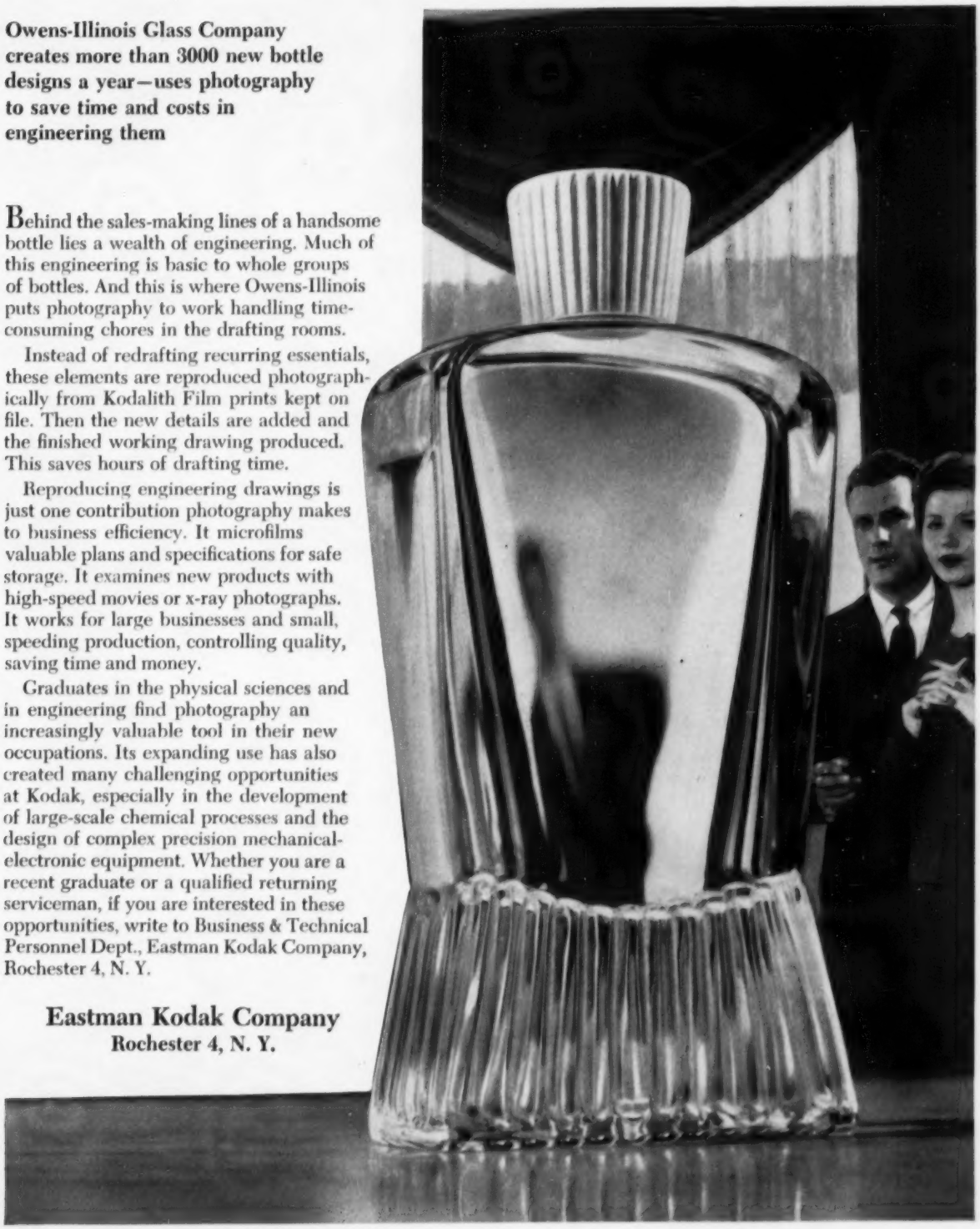
M.E.: "I like mathematics when it isn't over my head."

C.E.: "I feel the same way about pigeons."

Glass turns salesman

–as photography speeds bottle design

Owens-Illinois Glass Company creates more than 3000 new bottle designs a year—uses photography to save time and costs in engineering them



Behind the sales-making lines of a handsome bottle lies a wealth of engineering. Much of this engineering is basic to whole groups of bottles. And this is where Owens-Illinois puts photography to work handling time-consuming chores in the drafting rooms.

Instead of redrafting recurring essentials, these elements are reproduced photographically from Kodalith Film prints kept on file. Then the new details are added and the finished working drawing produced. This saves hours of drafting time.

Reproducing engineering drawings is just one contribution photography makes to business efficiency. It microfilms valuable plans and specifications for safe storage. It examines new products with high-speed movies or x-ray photographs. It works for large businesses and small, speeding production, controlling quality, saving time and money.

Graduates in the physical sciences and in engineering find photography an increasingly valuable tool in their new occupations. Its expanding use has also created many challenging opportunities at Kodak, especially in the development of large-scale chemical processes and the design of complex precision mechanical-electronic equipment. Whether you are a recent graduate or a qualified returning serviceman, if you are interested in these opportunities, write to Business & Technical Personnel Dept., Eastman Kodak Company, Rochester 4, N. Y.

Eastman Kodak Company
Rochester 4, N. Y.

Put science-engineering backgrounds to work in new General Electric research facilities

Up-to-the-future facilities such as G.E.'s $5 million Metals and Ceramics Laboratory recently dedicated at Schenectady, N. Y., offer unlimited opportunity for qualified applicants with backgrounds of science or engineering.

Historically one of America's research leaders, G.E. continues to expand facilities across the nation for exploring new developments for the home, industry and defense. Research conducted in this Metals and Ceramics Lab, for example, is destined to provide new materials for applications ranging from rockets and atomic power plants to labor-saving appliances. Here, inspecting the surface of a casting, are George Colligan, RPI, and Allan Kiesler, Missouri School of Mines (white shirts).

For careers offering professional growth, investigate G.E.'s Engineering and Science Program. You will be trained in the field of science or engineering most suited to your interests and aptitudes—building on technical backgrounds in physics, chemistry, math or these engineering fields: mechanical, electrical, electronic, metallurgical, nuclear, chemical, aeronautical. 956-3

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